ECOCLASS - A METHOD FOR CLASSIFYING ECOSYSTEMS

- A TASK FORCE ANALYSIS -

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January 18, 1973

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
INT Missoula FSL

REPLY TO: 1310 Planning January 18, 1973

SUBJECT: Classification and Description of Ecosystems

TO: Chief
Attention: M. J. Hassel, Team Leader
Multifunctional Program Planning Development Team, WO

Enclosed is the report of the Ecosystem Task Force established by your memorandum of December 22, 1971, to develop an ecosystem classification for the Pacific Northwest (Washington, Oregon, Idaho, Montana and Wyoming). We have adhered to our charter as closely as possible, making every attempt to develop a useful, sound classification system.

We feel assured that the ECOCLASS method will provide the necessary framework for forthcoming multiple use planning approaches, as well as providing a communication tool for interdisciplinary use in discussion of ecosystems. During the assignment, we obtained considerable supplementary information which is provided in the appendices of the report.

The Task Force members are in unanimous agreement on the ECOCLASS method for primary description and stratification of relatively permanent ecosystems. We hope that it can be implemented in multiple use planning at an early date.

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INTRODUCTION

During the past few years, the need for a comprehensive classification of ecosystems to aid in development of quality management of the National Forests has received National attention. The National Forest Management in a Quality Environment report[1/] lists this need as one of the major specific problems:

> PROBLEM 19--To develop and put into effect an adequate system to classify major forest types into suitable ecological subdivisions as a basis for improved forest description and management in coordination with range, wildlife habitat, and other resources.

In 1971, a Washington Office Special Committee completed evaluations of Region, Station, and Division comments on this problem, developed tentative guidelines for a National classification of ecosystems and recommended a course of action. Acting upon these recommendations, the Chief established this interdisciplinary Task Force to establish a classification system for the Pacific Northwest (Washington, Oregon, Idaho, Montana, Wyoming) based upon existing knowledge.

[1/] Cliff, Edward P. National Forest Management in a Quality Environment, USDA, Forest Service, 1971. 61 p. illus.

The guidelines that the Washington Office Committee provided are:

1. The purpose of the proposed classification system is to provide a unifying framework for the various functional interests within which research and management can be planned and executed. Each functional area of the Forest Service now classifies the landscape according to its particular system, and these systems reflect the particular interest involved. Although adequate for certain functional needs, our functional classification systems lack common elements; as a result, we are often unable to interrelate functional management plans and activities. Because of the multiple managerial goals and inherent complexity of the basic resources, we feel that only an ecosystem classification system can provide the unifying framework.

2. The classification should be hierarchial so it can be used at all organizational levels of planning. The classification system should have the capability for providing subdivision and aggregation appropriate to desired planning levels and accuracy requirements.

3. The lowest level of the hierarchy should consist of perceivable units of the landscape, homogeneous in climax vegetation and form and structure of the land. At this level of the hierarchy, units within the same class are expected to function and produce similarly and to respond similarly to management actions and natural perturbations. Ecosystems can be classified by an infinite number of dimensions. However, practical systems must be developed appropriate to resource management planning. This system should be based on relatively permanent abiotic features (climatic, edaphic, and topographic) of the landscape pertinent to resource management planning, and would provide a basis for interpreting the biotic resources in the planning process.

4. The classification should be developed upon existing knowledge. In some instances, we may not be able initially to characterize lower levels of the hierarchy because of lack of on-the-ground knowledge. Where this is the case, management planning must be based upon existing knowledge at higher levels--even though this lack of knowledge may restrict the accuracy of management planning in local areas. As research and management gain additional knowledge and experience, the lower classification levels can be refined.

Using these guidelines the Task Force proceeded to develop the method of ecosystem classification that follows. This report is providing a method, not a complete classification. The method, which we have termed ECOCLASS, should provide a unifying framework for completing the classification. An appendix is provided for more detailed information on the systems incorporated herein.

THE ECOCLASS METHOD

ECOCLASS links Terrestrial Ecosystems and Aquatic Ecosystems. Both vegetation and land characteristics are needed to describe the Terrestrial Ecosystems. Aquatic Ecosystems, a portion of land covered with water all or most of a year, require description of aquatic characteristics as well as influencing terrestrial characteristics. The ECOCLASS method is used to link these ecosystems through the common bond of the Land System. The outline of the Vegetation, Land, and Aquatic Systems of ECOCLASS and their possible linkages are shown in figure 1.

Levels within each System are designed for grouping together similar or closely related units of the next lower level. For example: several similar Landunits are grouped into a specified Landtype; several closely associated Landtypes are grouped into a kind of Landtype Association; several Landtype Associations may be found in a Subsection, etc. Thus, the land manager can choose whatever level of detail from each system that he requires for his particular need.

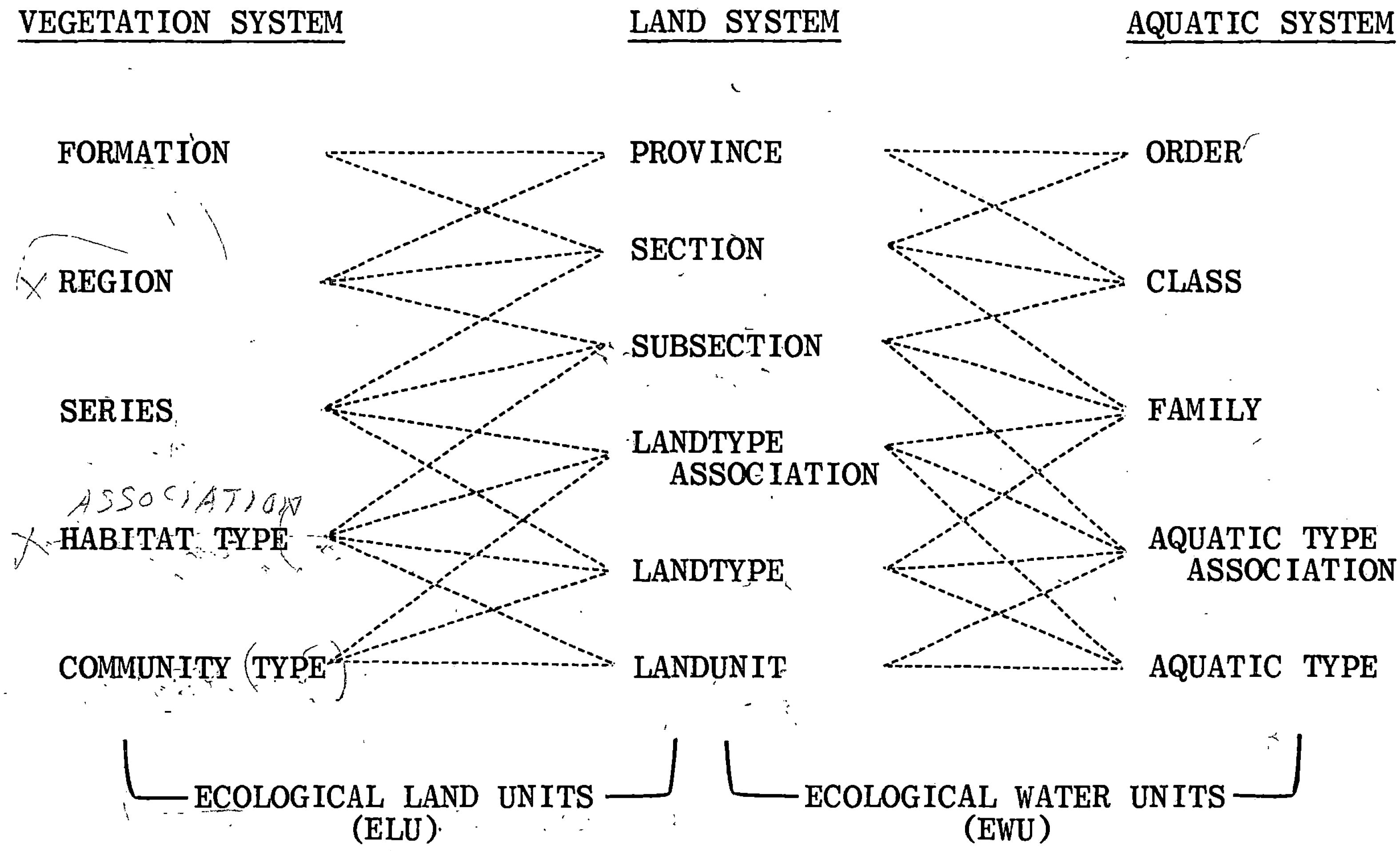

Figure 1.--Basic systems of the ECOCLASS method, showing the hierarchial classifications and possible combinations. Ecological Land Units comprise linkages between the Vegetation and Land Systems. Ecological Water Units are the linkages between the Aquatic and Land Systems.

Each classification system provides essential and unique input for characterizing Terrestrial or Aquatic ecosystems. For Terrestrial Ecosystems, information concerning vegetation resources and related environmental factors is provided by the Vegetation System; physical parameters are provided by the Land System. For Aquatic Ecosystems, aquatic characteristics must be combined with physical, chemical and biological characteristics from upstream areas. The Land and Vegetation Systems are closely linked in Terrestrial Ecosystems, because both are needed to describe the same piece of land. Aquatic Ecosystems are a composite of upstream influences and adjacent land and vegetation influences, because of the fluid nature of the water and bedload.

Lines connecting Vegetation, Land and Aquatic Systems show possible combinations between various levels of each system (fig. 1). Linkages between the Vegetation and Land Systems to describe the Terrestrial Ecosystems are termed Ecological Land Units. Linkages of the Aquatic System to the Land System are termed Ecological Water Units, providing an integrated description of Aquatic Ecosystems. All three systems are considered together in planning and management, although specific needs or availability of information may require different levels of detail. Thus, ECOCLASS is not restricted to combinations of equivalent levels. For example, a Series (e.g., Ponderosa pine climax potential) can be combined with a Subsection such as the Southern Blue Mountains in Oregon. The Southern Blue Mountain Subsection would contain several different Series. Aquatic resources of the Southern Blue Mountains in Oregon would be drainages like the North Fork Crooked River if described at the

Aquatic Type Association level. More specific information would be provided at the Aquatic Type level.

Land capable of supporting a Ponderosa/Fescue climax community on a moderately dissected plateau would be a combination of Habitat Type with Landtype Association. A Ponderosa/Fescue Habitat Type on moderate canyon toeslopes would constitute combination with Landtype. The smallest and most precise Ecological Land Unit would be Community Type combined with Landunit such as a stable Ponderosa/Fescue community on southerly toeslopes of 10 to 30 percent with soils derived from volcanic ash (fig. 2). With a steep gradient mountain stream flowing at the foot of the above Ecological Land Unit one would have an example of Aquatic Type, Landunit and Community Type in an association that occurs commonly (fig. 2).

Thus, ECOCLASS is flexible. It is a method that can accommodate and integrate data at any level for a wide variety of land management needs. This flexibility is further illustrated by two specific examples; the first at a very broad level of information needs and the second requiring very detailed information.

The FALCON program requires tabulation of location and extent of all areas in the Western States where new and innovative logging systems are needed. Landtype Associations whose characteristics indicate sensitivity to logging (Steep, Dissected Canyon Lands) would be selected for combination with a Vegetation Region depicting good to excellent forest productivity (Temperate Mesophytic Coniferous Forest). These areas are identified by a combination of Landtype Associations and Vegetation Regions.

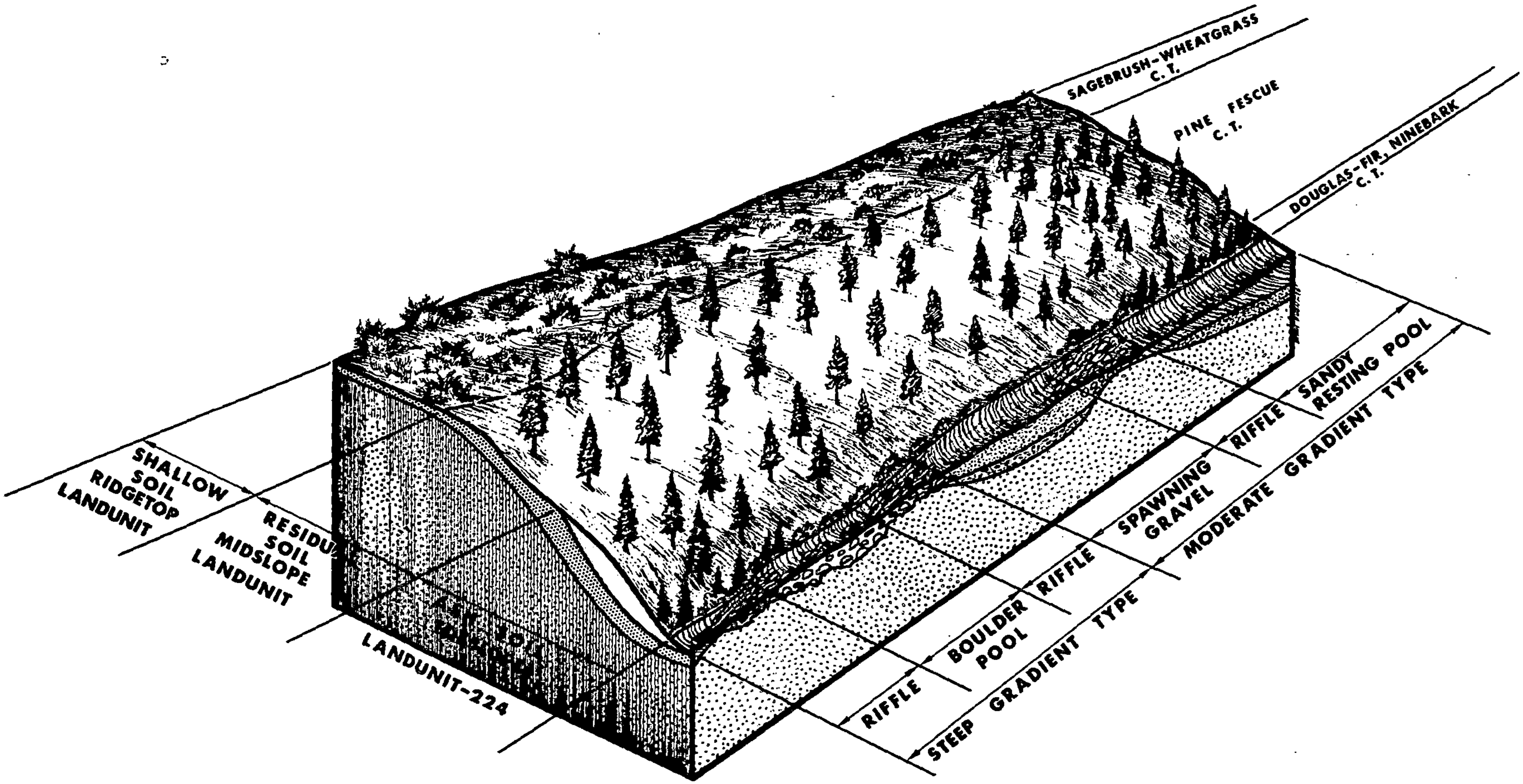

Figure 2.--Block diagram illustrating Vegetation, Land, and Aquatic Systems. Individual Aquatic Sites are shown in two Aquatic Types. Three Landunits and three Community Types occupy the same area of land.

The need for detailed characterization and mapping of both Terrestrial and Aquatic Ecosystems has been recently demonstrated for the Oregon Dunes National Recreation Area. A five-man team characterized and mapped at the Community Type, Landunit and Aquatic Order-Aquatic Class levels. On this 32,000 acre area, 28 Ecological Land and Water Units were designated including: (1) "hummocks-occasionally wet" (water table at the surface during winter, patchy beachgrass) - 2,680 acres; (2) "deflation plain-grass, sedge, low shrub" - 5,350 acres; (3) "mountain front, tableland, transition forest (Sitka spruce-mountain hemlock/evergreen huckleberry) - 1,230 acres; and (4) all lakes in the study area - 900 acres. The information contained in their report (342 pages) is considerably more precise for land and vegetation than that generally required for National Forest System management planning.

THE VEGETATION SYSTEM

The Vegetation System is founded upon the fact that plant communities are meaningful integrators of interacting environmental factors (soils, landform, and climate). These units are interpreted in terms of (a) predicting successional trends, (b) potentials for vegetative productivity, and (c) management opportunities and limitations. Units of the System are named for their dominant species or kinds of plants as follows:

NAME	DEFINITION AND EXAMPLES[2/]
Community Type (C.T.)	Collective term for those areas of land supporting or capable of supporting the same type of stable plant community (Cheatgrass-Sandberg Bluegrass, Bluebunch Wheatgrass-Sandberg Bluegrass). Some are equivalent to a habitat type (e.g., Ponderosa/Fescue) whereas others are a subdivision of a habitat type to recognize dominant subclimax stages of succession (e.g., Lodgepole/Grouse Whortleberry C.T. and Alpine Fir/Grouse Whortleberry C.T. subdivisions of an Alpine Fir/Grouse Whortleberry H.T.).
Habitat Type (H.T.)	Collective term for those areas capable of supporting the same climax plant association (Bluebunch Wheatgrass-Sandberg Bluegrass H.T., Ponderosa Pine/Bitterbrush H.T., etc.).
Series	Groups of Habitat Types having a common climax dominant species (Bluebunch Wheatgrass Series, Ponderosa Pine Series, etc.).
Region	Groups of Series with similar physiognomy and climatic controls (Steppe Grassland Region, Montane Grassland Region, Temperate Mesophytic Coniferous Forest Region, etc.).
Formation	Groups of Regions with similar physiognomy (Grassland Formation, Coniferous Forest Formation, etc.).

[2/] See Appendix A for additional detail.

THE LAND SYSTEM

The Land System is founded upon the fact that land areas result from specific combinations of soils, geology, land shape and climate. These land areas are interpreted in terms of suitability and limitations for various kinds of land treatments. Units of the system are as follows:

NAME	DEFINITION AND EXAMPLES[3/]
Landunit	The lowest unit of the system composed of closely related sites having uniform land shape (Landunit 224--soil from volcanic ash over stoney clay--Tolo series--on a toeslope of 10 to 20 percent facing south).
Landtype	Groups of land units having similar land shape (Landtype 31--deep, medium textured cold soils on dissected mountain slopes).
Landtype Associations	Landtypes grouped according to their association with each other (Dissected Plateau, Canyon Breaks, Glacial Scoured Uplands).
Subsection	Groups of Landtype Associations with similar geologic history and physiognomy (Rejuvenated Lands, Basin Lands, Alpine Glaciated Lands).
Section	A specific land area with characteristic topographic, geologic and hydrologic properties in which any kind of Landunit, Landtype, Landtype Association or Subsection may fall (Idaho Batholith, Snake River Plains, Okanogan Highlands).
Province	A major land area made up of several Sections (Northern Rocky Mountains, Columbia Intermontane, Basin and Range).

[3/] See Appendix B for additional detail.

THE AQUATIC SYSTEM

The Aquatic System is based on the fact that waters of similar characteristics have similar capability to produce goods and services. Their limitations to use and response to management are also similar. Marshes, lakes, rivers, estuaries, and oceans have obvious similarities within each of the categories.

Since land and vegetation greatly influence water, their characteristics are involved in describing aquatic units, although lines will be drawn around only those parts of the landscape covered with water all or most of the year. Because there is no generally accepted aquatic classification system, the following is proposed:

NAME	DEFINITION AND EXAMPLES[4/]
Aquatic Type	A relatively homogeneous stream, a lake, a marsh, an estuary. Where the unit under consideration is diverse and large, it may be subdivided into smaller manageable units such as a reach of stream, a part of a lake or marsh, a bay or a slough or an estuary. (Steep, fluvial headwaters stream; steep, fluvial small stream.)
Aquatic Type Association	Aquatic Types grouped according to their association with each other, usually on a drainage basis (Dissected Mountain Stream).
Aquatic Family	Aquatic Type Associations grouped largely by temperature (Cold Streams, Warm Streams, Alpine Lakes, Lowland Lakes).
Aquatic Class	Grouping of Families based primarily on their physical character (Streams, Lakes, Marshes).
Aquatic Order	Groups of Classes based primarily on salinity (Freshwater, Inland Salt Lakes, Oceans, Estuaries).

4/ See Appendix C for additional detail.

ECOCLASS UNITS

The units of the ECOCLASS method are designed to meet planning needs at all levels of management. This Task Force was charged with developing a single classification of ecosystems based on permanent characteristics. However, a single classification would not provide the long-term flexibility to meet all levels of planning needs. The unique contribution of ECOCLASS is the concept of linking the inherent strengths of Vegetation, Land, and Aquatic Systems. These linkages, termed Ecological Land Units and Ecological Water Units, provide the opportunity for interdisciplinary communication about ecosystems and their management.

ECOLOGICAL LAND UNITS

The validity of the Ecological Land Unit (ELU) is only as good as the quality of input from both the Land and Vegetation Systems. Choosing the appropriate level of each System will depend on (a) the type of planning, and (b) the general characteristics of the planning area. For instance, in areas of extremely high erosion hazard, land considerations may have the greatest influence on management decisions; thus, the greater effort and more detailed stratification should be in the Land System. In contrast, in areas of stable land having low erosion hazard, the vegetation considerations may have the greatest influence on management decisions; thus, stratification should be of more detail for the Vegetation System than for the Land System.

The lowest common level of the ELU that is homogenous in (potential) climax vegetation and form and structure of the land is the Habitat Type-Landunit. The most precise level of the ELU is the Community Type-Landunit. These perceivable units of the landscape are the most homogeneous in existing stable vegetation and form and structure of the land. Prediction of function and response to management activities are possible with greater accuracy than at any other levels of ELUs.

A Community Type has a specified composition of (a) trees, shrubs, and herbaceous species for forest stands; (b) shrubs and herbaceous species for shrublands; and (c) herbaceous species for grass or herblands. It is named after at least two characteristic species, such as Ponderosa Pine/Idaho Fescue, Big Sagebrush/Bluebunch Wheatgrass, or Idaho Fescue/Buckwheat. Community Types and Habitat Types have characteristic patterns of plant succession following disturbances such as logging, wildfire, or overgrazing. They have specified levels of productivity such as cubic-foot volume growth for trees, browse production for shrubs, and herbage production for herbaceous plants. Silvicultural guides as well as range condition and trend guides for both livestock and wildlife are based upon Community Types and Habitat Types.

The Landunit identifies an area in terms of soil characteristics, slope shape, aspect, and steepness. It has one or more specific kinds of soils: if it has more than one, the soils are closely related genetically and morphologically. Soil and slope interrelationships are described as to how they (a) influence erodibility, land stability, compactibility, moisture handling characteristics, soil temperature; (b) are suitable for land treatment practices, such as reforestation, revegetation, or road and trail construction; and (c) influence subsurface moisture characteristics which may be important for road and dam construction or for drainage and sanitary facilities. Engineering guides for determining slope stability and surface water runoff, and guides for determining surface erosion potential are based largely upon behavior of Landunits.

A Community Type or Habitat Type can occur on different Landunits. Some vegetation parameters, such as productivity and regeneration problems, are influenced by and can be interpreted from Landunits. Combining Community Type or Habitat Type with Landunit provides characteristics drawn from the two systems that prescribe productive capacity, limitations, opportunities, and responses to a wide variety of land management alternatives. For example, description and interpretation of an Ecological Land Unit comprised of a Habitat Type and Landunit might read as follows:

Ponderosa Pine/Fescue--Landunit 224 (See Figure 2)

Ponderosa pine is the only tree species capable of growing on this site; site index averages 60; but low moisture indicates limited stockability, therefore, growth potential is only 20 cu. ft./acre/yr., fire scars indicate ground fires occurred at 15- to 20-year intervals, palatable shrubs are not present and cannot be satisfactorily introduced; herbage production averages 500 pounds per acre under average forest stand conditions; an unusually wide variety of herbaceous species could provide good spring game forage but poor summer forage because the vegetation dries by mid-June; toeslope position and slopes 10 to 20 percent indicate topography would be highly suitable for livestock grazing and for tractor logging; ash soils indicate that erosion would be severe when the surface soil is exposed to wind or water; moderate fertility of ash soils and good early season soil moisture supply indicate good opportunities for range revegetation with bunch-type grasses and for artificial tree regeneration; south exposure on toeslope and highly competitive fescue severely limits natural tree regeneration; the ash soils resist compaction and have very low bearing strength when wet during spring runoff; dust problems tend to be maximal during summer and fall; therefore, these soil conditions should be considered in timing logging, livestock grazing and campground planning. Also, volcanic ash soils have rapid lateral water movement over buried soil or bedrock, which will create sewage effluent pollution problems for stream at the foot of these toeslopes; ash soils also are poor material for road construction; clayey subsoils will restrict roadbed sub-grade drainage; stable toeslope and moderate degree of slope indicate road cut and fill failure should be minimal, but culvert drainage needs are high due to runoff accumulation in the toeslope position and hazard of soil erosion where culverts spill.

ECOLOGICAL WATER UNITS

An Ecological Water Unit (EWU) is a combination of an Aquatic System unit related to a Land System unit. The most precise level of EWU is the Aquatic Type - Landunit. Prediction of management capability, limitation, and response is more accurate at this level than at higher levels. An Aquatic Type has a specified combination of physical, chemical and biological characteristics. The associated Landunit describes the setting for the Aquatic Type in terms of soil characteristics, slope, shape, aspect and steepness.

The physical characteristics of aquatic systems are determined largely by characteristics of the adjacent and underlying land. Chemical characteristics of the water are largely derived from the land. Contiguous vegetation also influences the characteristics of an aquatic system, sometimes as much as the land. Physical and chemical characteristics of the water provide conditions for the kinds of aquatic plants and animals that are present. These, in turn, provide the goods and services for people. Management can influence the yield of goods and services of an aquatic system, and response can be predicted based on its characteristics.

Limitations of what the aquatic system will produce frequently depends more on what is done to the land and vegetation than what is done to the aquatic system itself. Erosion of unstable soil, including streambanks, can be accelerated by road construction, logging, livestock grazing, wildlife use, etc., thereby reducing the yield of goods and services. Increases in erosion increase the suspended sediment load in the aquatic system which can (1) reduce fishing and recreational use, (2) reduce photosynthesis of aquatic plants, (3) reduce the production of fish food organisms (aquatic insects, etc.), (4) reduce the survival of incubating fish eggs, and (5) reduce survival of juvenile fish by filling interstices (cover). These same activities can reduce contiguous vegetation, which can (1) increase water temperatures because of solar radiation, (2) reduce cover for fish, (3) reduce leaf-fall (nutrient inflow), and (4) reduce inflow of terrestrial insects (fish food).

As an example, the description and interpretation of an Ecological Water Unit might be as follows:

<u>Dissected Mountain Stream--Landunit-224--Ponderosa Pine/Fescue</u>
<u>(See Figure 2)</u>

A moderately dissected mountain stream (Aquatic Type Association) flowing along the foot of 10- to 20-percent toeslopes of volcanic ash soils over clayey subsoils or bedrock (Landunit-224). Ponderosa/fescue is the Community Type with a thin stringer of Douglas-fir/ninebark along the stream. The stream flows from east to west indicating that shading vegetation on the south side of the stream is important for shading to prevent temperature increases while that on the north side is not. Understory of ninebark is adequate for shading; Douglas-fir can be harvested if ninebark is protected. The well vegetated streambanks are stable and provide excellent cover for fish. Because of low bearing strength of the ash soils when wet, livestock should not be turned on until late in the spring and should be managed so they do not congregate along the streambanks and break them down. Logging during wet season can be expected to cause erosion and turbid water in stream because soil erosion hazard is high. Use of dirt or gravel roads during wet periods can also be expected to make the stream turbid. High stream gradient of 9 percent has high potential for sediment transport and erosion of streambanks, although mean high streamflow of 4.8 cfs indicates that runoff is usually moderate. Mean low streamflow of 0.3 cfs, small width (3 feet) and depth (3 inches), poor structure (small and shallow), and riffle-pool ratio indicate the stream has low potential for producing catchable-size trout. Because it empties directly into a large river, it has the potential as a spawning and nursery area for resident cutthroat and anadromous steelhead trout.

DEVELOPING THE ECOLOGICAL UNITS

Planning in an ecosystem framework requires a team approach. Selection of the appropriate levels of the Vegetation, Land, and Aquatic Systems for a particular planning assignment requires consultation among the various disciplines involved. Delineation and interpretation of Ecological Land Units and Ecological Water Units can be accomplished in more than one way.

One approach is to assign a team to the complete job of characterization, mapping and interpretation of units in a specific planning area. This team can work somewhat independently in collecting data and correlate their inputs following the field work. Or, the team can work very closely in the field as well as in the office. The Oregon Dunes National Recreation Area Planning is a good example of this coordinated team approach.

Another approach is to gather the Vegetation, Land, and Aquatic information independently and rely on overlays to describe the units for planning. This approach is more appropriate if some of the Systems in the planning area has previously been described for other purposes and re-mapping of these systems is not necessary for planning. A team approach for integration and interpretation of the overlays is also required with this method. The Tailholt-Circle End example in Appendix D and the FALCON example illustrate this overlay approach.

Advantages and disadvantages can be cited for either approach. The coordinated team approach allows better interdisciplinary communication in defining and interpreting the Ecological Land Units and Ecological Water Units. However, unless the individual Vegetation, Land, and Aquatic Systems are also identified, future use of the stratification may be limited. Since different linkages may be needed for future planning, the individual Systems should maintain enough integrity to allow regrouping without additional field work. The overlay approach maintains the identity of the Vegetation, Land, and Aquatic Systems. However, the opportunity for interdisciplinary communication of the interrelationships between the Systems is limited. The approach to use for a specific planning area also depends upon the present availability of information as well as the availability and timing of needed team member skills. Both the coordinated team approach and the overlay approach are accommodated by the ECOCLASS method.

USE OF ECOCLASS

The ECOCLASS method provides a tool for classifying ecosystems according to relatively permanent characteristics. As a tool, it provides only certain kinds of interpretations that can be used as input for the decision making process. ECOCLASS is also designed for maximum flexibility; thus it can be utilized at all planning levels.

INTERPRETATION

Ecological Land Units form only a foundation upon which land management alternatives may be evaluated. The Land System units are relatively unchangeable and may be used directly in appraising management alternatives. (The kinds of information provided by the Land System were described on page 12.) The Vegetation System is useful primarily in formulating a basic understanding of vegetation potentials and it also is relatively unchanging. (The kinds of information provided by the Vegetation System are described in Appendix A.) The land manager will require other maps characterizing <u>current status</u> of vegetation and animals. These are standard functional inventories depicting timber stand conditions, range type and condition, and animal distribution for wildlife and livestock. Engineering needs may require specific types of land information on very local sites.

Interpretation of Aquatic System units is highly dependent upon associated land and vegetation characteristics. Hydrologic and geologic characteristics of Land System units are of primary importance in characterizing stream and lake bottoms, basic water properties, and streamflow variation over the season. Therefore, sound interpretation of Aquatic System units requires knowledge of Vegetation and Land System units on the same area, as well as relating upstream influences to downstream characteristics. This relationship is provided with ECOCLASS and the concept of the Ecological Water Unit. In addition land activities, such as road construction, logging, and grazing by domestic animals, are major influences on water characteristics and biotic productivity of Aquatic Ecosystems. This knowledge of past and proposed activities is not provided with ECOCLASS. However, it must be incorporated to evaluate response of Aquatic Ecosystems.

Thus, ECOCLASS provides interpretations based on permanent characteristics of the Terrestrial and Aquatic Ecosystems. These interpretations are primarily useful for identifying potentials as well as predicting responses to management actions and natural disturbances. Sound management decisions also require knowledge of present resources, transportation systems, and socio-economic considerations. ECOCLASS does not substitute for these information needs. ECOCLASS is limited to providing a means of interdisciplinary communication for evaluation of potentials, limitations and responses of ecosystems to aid in land management planning.

PLANNING AND DECISION MAKING

The design of the ECOCLASS method is well suited for incorporation into current techniques of multiple use planning. For example, the INFORM system has two general groups of programs that relate directly to handling information for planning and decision making, such as that from ECOCLASS. The GELO map handling process can accommodate maps of Vegetation, Land, and Aquatic System units as well as the Ecological Land Units and Ecological Water Units. In addition, producing maps of higher levels in the system from more detailed maps (aggregation) or producing maps combining levels from different systems (Ecological Land and Water Units) should also be feasible. The FS-GIM data management system can handle the data and information collected from the stratified units of ECOCLASS. This information can be retrieved by itself for use or can be retrieved and displayed on maps by using the GIM and GELO processors together.

ECOCLASS will <u>not</u> make land management decisions. The land manager must interpret each ECOCLASS mapping unit according to those characteristics significant for his particular resource management problem. In many cases, characteristics of an individual ECOCLASS mapping unit will not be sufficient; the interrelationship (juxtaposition) of different mapping units is often a key to sound planning and decision making. For example, a fine stand of timber on gentle slopes suitable for tractor logging cannot be intensively managed if intervening lands are inimical to road construction, thereby preventing access.

FLEXIBILITY

ECOCLASS has sufficient flexibility for use at all levels of planning. The land manager may choose appropriate levels of detail from each System for a particular planning problem. Obviously, information concerning resource capabilities, limitations, and responses becomes progressively diluted as one proceeds to higher classes in the hierarchy. On the other hand, elimination of superfluous detail will reduce costs. The Oregon Dunes and FALCON examples, illustrated flexibility. The Tailholt-Circle End example in Appendix D was prepared especially to illustrate flexibility on a given area of land, offering several alternatives of stratification. The lowest level classification units are well suited for detailed project planning, whereas the highest level classification units are better suited for Regional or National planning. Within the hierarchy, a land manager should be able to find a level appropriate for each type of planning problem he is faced with.

STATUS

ECOCLASS provides a hierarchial framework for ecosystem classification for the five northwestern states of Washington, Oregon, Idaho, Montana, and Wyoming. This framework provides a base for improved communications with described units as common points of reference. Classification and mapping is generally completed for the higher Vegetation, Land, and Aquatic levels, although adequate information is not presently available to complete the classification at lower levels of the hierarchy. The current status of classification and of mapping for the Vegetation, Land, and Aquatic Systems are discussed in more detail in Appendices A, B, and C, respectively.

APPENDIX A -

THE VEGETATION SYSTEM

APPENDIX A - THE VEGETATION SYSTEM

The Vegetation System of ECOCLASS is for classifying and mapping areas of land based on their potential for vegetative development. Although existing vegetation is of great importance for planning, ECOCLASS does not necessarily provide this information. Existing vegetation can be brought into the planning process through functional inventories and current maps, rather than as a part of a permanent classification and mapping of ecosystems.

The hierarchial classification, presented on page 7 of the main report, provides five levels of classification. The lowest levels for collection and development of planning information are either the Habitat Type or the Community Type. These two levels are similar in many respects. The Habitat Type term was developed by Daubenmire (2) and requires identification of a potential climax to name the Habitat Type. It is currently being used as the basic building block in Montana, Wyoming, Idaho and for some study areas in Oregon and Washington. The Community Type is a restricted definition, currently in use in Regions 4 and 6 of the U.S. Forest Service. It is used because of some uncertainty regarding climax, per se, and because the abundance of stable subclimax communities can also be interpreted in the same context as Habitat Types. The main difference is that the name for these environmental subdivisions is not restricted to climax in a Community Type. Thus, Community Types also describe current dominant vegetation to a certain extent. As with Habitat Types, major disturbance of the plant community (e.g. clearcutting) does not change the Community Type. It still represents a unit of land, having a narrow range of environmental variation and a given potential for vegetative development. The Habitat Type and Community Type (as defined in this report) represent mainly a difference in terminology in different geographic areas within the Pacific Northwest. Locally, one or the other will be used at the present state of knowledge. However, the philosophy and concepts are similar and they can be compared with each other across Regional boundaries. Since this task force was charged with using currently available information, both Habitat Types and Community Types are used. Eventually, as more studies are completed, the Habitat Types and Community Types should both be developed for the entire Pacific Northwest. For a complete understanding, we must describe both the climax and subclimax relationships within either approach. Some latitude in approach for new areas is acceptable as long as communications are not impaired. Because of the potential communication problem our definition of Community Type is restricted to: A Community Type is either equivalent to a Habitat Type or a subdivision thereof; it does not encompass greater environmental variation than a Habitat Type.

The basic building blocks for collecting data and development of management information in the Vegetation System are the Community Type or the Habitat Type. These are the levels where research results can most

reliably be applied. Kinds of management information provided are: timber productivity potential; forage and wildlife habitat production potential at different successional stages; response of vegetation to specific types of disturbance such as grazing, burning, logging, and site preparation; choice of species to favor in management; esthetic recovery rates following disturbance; and certain specific environmental (abiotic) characteristics reflected by the Vegetation Classification System. Information for higher levels in the classification (e.g., Series, Region) are provided by extrapolating from the Habitat Type or Community Type information, based on the relative proportions of different Habitat Types or Community Types in the higher level. Management information becomes more general and less accurate at progressively higher levels in the hierarchy.

STATUS OF THE CLASSIFICATION SYSTEM

The proposed classification is presented through the Series level in Table 1. The six Formations and eleven Regions are essentially completed. The 18 Series in the Coniferous Forest Formation are also essentially complete and currently usable. The proposed Series in the other Formations are only complete for certain areas and require further study. The Series listed under the Alpine Formation are particularly questionable. Nevertheless, this presents the most realistic system currently available. The number of Habitat Types currently described for each Series gives an indication of the amount of environmental diversity within a Series, to the extent that Habitat Types have been described for that Series. Firming up of Series will accompany completion of the classification at the Habitat Type level.

A classification scheme for Habitat Types and/or Community Types in the Northwest is far from complete, although generally it is more advanced for the Coniferous Forest Formation than for other Formations. Classifications now exist for coniferous forests of northern Idaho, eastern Washington, northwestern Montana and the Blue Mountains and pumice areas of Oregon, for the Steppe Grassland and Shrubland Regions of Washington, and for several isolated geographic areas. Habitat Type classification schemes are actively being developed for all of the Coniferous Forest Formation in Montana, Idaho, and Wyoming and for the Montane Grassland and Shrubland Regions in Montana. Development of Habitat Type classifications is progressing at a considerably slower pace elsewhere in the Northwest despite the avid interest expressed in this classification unit by the land manager.

Table 1.--Hierarchial classification for Formations, Regions and proposed Series in the five northwestern states

	Habitat types	Reference
	(No.)	
1. ALPINE FORMATION		
ALPINE REGION		
Deschampsia caespitosa Series	?	14, 22, 28
Festuca ovina Series	?	1, 15, 18, 11, 27
Geum rosii Series	?	14, 28
Carex spp. (Upland) Series	?	1, 14, 18, 27
Carex spp. (Bog) Series	?	14
Phyllodoce empetriformis Series	?	1, 18, 11
Salix spp. Series	?	14, 11
(Other Series?)		
2. GRASSLAND FORMATION		
a. STEPPE GRASSLAND REGION		
Sporobolus cryptandrus Series	1+	5
Aristida longiseta Series	1+	5
Distichlis stricta Series	1+	5
Elymus cinereus Series	1+	5
Bouteloua gracilis Series	?	30, 17
Stipa comata Series	1+	5
Agropyron smithii Series	?	-
Agropyron spicatum Series	3+	5, 10, 17, 30
Festuca idahoensis Series	3+	5, 10, 17
(Other Series?)		
b. MONTANE GRASSLAND REGION		
Stipa comata Series	3+	22
Agropyron spicatum Series	2+	11, 16, 17, 21, 22, 27
Festuca idahoensis Series	6+	11, 13, 16, 21
Festuca scabrella Series	4+	11, 16, 19, 22
Deschampsia caespitosa Series	1+	25, 27

Table 1.--continued

	Habitat types	Reference
	(No.)	
b. MONTANE GRASSLAND REGION (continued)		
Festuca viridula Series	?	24, 29
(Dry Meadow) Series	?	27
(Moist Meadow) Series	?	27
(Other Series?)		
3. SHRUBLAND FORMATION		
a. CHAPARRAL REGION		
Ceanothus cuneatus Series	?	6, 10
Arctostaphylos viscida Series	?	6, 10
Arctostaphylos canescens Series	?	6, 10
(Other Series?)		
b. STEPPE SHRUB REGION		
Artemisia tridentata Series	4+	5, 10, 17, 20
Artemisia tripartita Series	3+	5, 10
Artemisia arbuscula Series	2+	12
Artemisia rigida Series	?	5
Purshia tridentata Series	3+	5, 10
Eurotia lanata Series	1+	5
Grayia spinosa Series	1+	5
Sarcobatus vermiculatus Series	1+	5, 17
(Other Series?)		
c. MONTANE SHRUB REGION		
Artemisia tridentata Series	8+	10, 20, 22, 27
Artemisia tripartita Series	?	20, 27
Artemisia arbuscula Series	3+	22, 27
Artemisia cana Series	?	22, 27
Purshia tridentata Series	?	-
Cercocarpus ledifolius Series	?	17, 27
Crataegus douglasii Series	2+	5
Celtis douglasii Series	1+	5

Table 1.--continued

	Habitat types	Reference
	(No.)	
c. MONTANE SHRUB REGION (continued)		
Rhus glabra Series	3+	5
Rhus trilobata Series	?	-
4. WOODLAND FORMATION		
a. CONIFEROUS WOODLAND REGION		
Juniperous occidentalis Series	4+	7, 17
Juniperous scopulorum Series	?	-
(Other Series?)		
b. DECIDUOUS WOODLAND REGION		
Quercus garryana Series	?	10, 17
Quercus kelloggii Series	?	10
(Other Series?)		
5. CONIFEROUS FOREST FORMATION		
a. MONTANE TAIGA (SUBALPINE) REGION		
Picea glauca Series	3	4, 23
Abies lasiocarpa Series	16	2, 4, 9, 11, 23, 27
Picea engelmannii Series	1	26
Pinus albicaulis-Abies lasiocarpa Series	1	2, 23, 26, 27
Pinus albicaulis-Pinus flexilis Series	1	26
Abies amabilis Series	12	9
Tsuga mertensiana Series	2	2, 23
Chamaecyparis nootkatensis Series	1	9
~~*Abies amabalis*~~ Series	3	9
b. TEMPERATE MESOPHYTIC FOREST REGION		
Tsuga heterophylla Series	5	2, 9, 10, 23
Thuja plicata Series	3	2
Abies grandis Series	4	2, 11, 23
Picea sitchensis Series	?	3

Table 1.--continued

	Habitat types	Reference
	(No.)	
b. TEMPERATE MESOPHYTIC FOREST REGION (continued)		
Abies concolor Series	?	10
Abies magnifica shastensis Series	?	10
Pseudotsuga menziesii Series	4	2, 4, 10, 23, 26, 27
Pinus contorta Series	2?	9, 10
c. TEMPERATE XEROPHYTIC FOREST REGION		
Pinus ponderosa Series	18	2, 4, 8, 11, 23, 27
6. DECIDUOUS FOREST FORMATION		
a. TEMPERATE MESOPHYTIC FOREST REGION		
Populus tremuloides Series	1	26

STATUS OF MAPPING OF THE CLASSIFICATION UNITS

In the Vegetation System, development of the classification logically precedes the mapping job. Maps are available for the Formations, except for the Deciduous Forest Formation. Maps for the Regions and Series, have not been developed specifically in line with the proposed classification. However, Kuchler's (17) map of potential vegetation does a very comprehensive and reasonable job of identifying the Vegetation System at a level somewhere between the Region and the Series. His map is available at a scale of 1:7,500,000 (Figure 3) or at the original scale of 1:3,168,000 (Figure 4) with 62 mapping units for the western United States. The strong advantage in using this map is that it is the best information currently available for indicating potential vegetation. With some interpretation of the characteristics of his defined types, they are currently usable for broad planning for large areas. The types occurring in the five northwestern states and their area are listed in Table 2. The names indicate that Kuchler's types include: (1) groups of Series, (2) Series, (3) part of a Series, and (4) groups of Habitat Types.

Kuchler's type descriptions need to be carefully studied and related to the proposed Biotic Potential System. The basic interpretive input for the Vegetation System comes from the Habitat Type and Community Type levels. Therefore, to properly utilize Kuchler's types, we need to define what they include in terms of Series, Habitat Types, and Community Types. The accuracy of Kuchler's map should also be tested as Habitat Type and Community Type maps are developed.

Mapping of Habitat Types is currently being conducted in the National Forests of Idaho and Montana as the classifications become available. Several small areas have been mapped at scales of 8 inches = 1 mile and 4 inches = 1 mile. These include experimental areas and timber sales. The first major effort to map large areas is the Coeur d'Alene N.F. at a scale of 2 inches = 1 mile, completed in 1972. This mapping job was conducted in conjunction with the timber inventory, aiding considerably in the efficiency of obtaining ground-truth data. The St. Joe and Bitterroot National Forests were inventoried in 1972 and Habitat Type maps are currently being prepared. Several Forests are also mapping large drainages as part of their multiple-use planning. In Oregon, much of the Blue Mountains have been mapped at the Community Type level and the pumice zone of south central Oregon is currently being mapped. The capability of getting the mapping job done rather quickly, following completion of the classification, is made possible because foresters can be trained to do the mapping and some of the interpretive work.

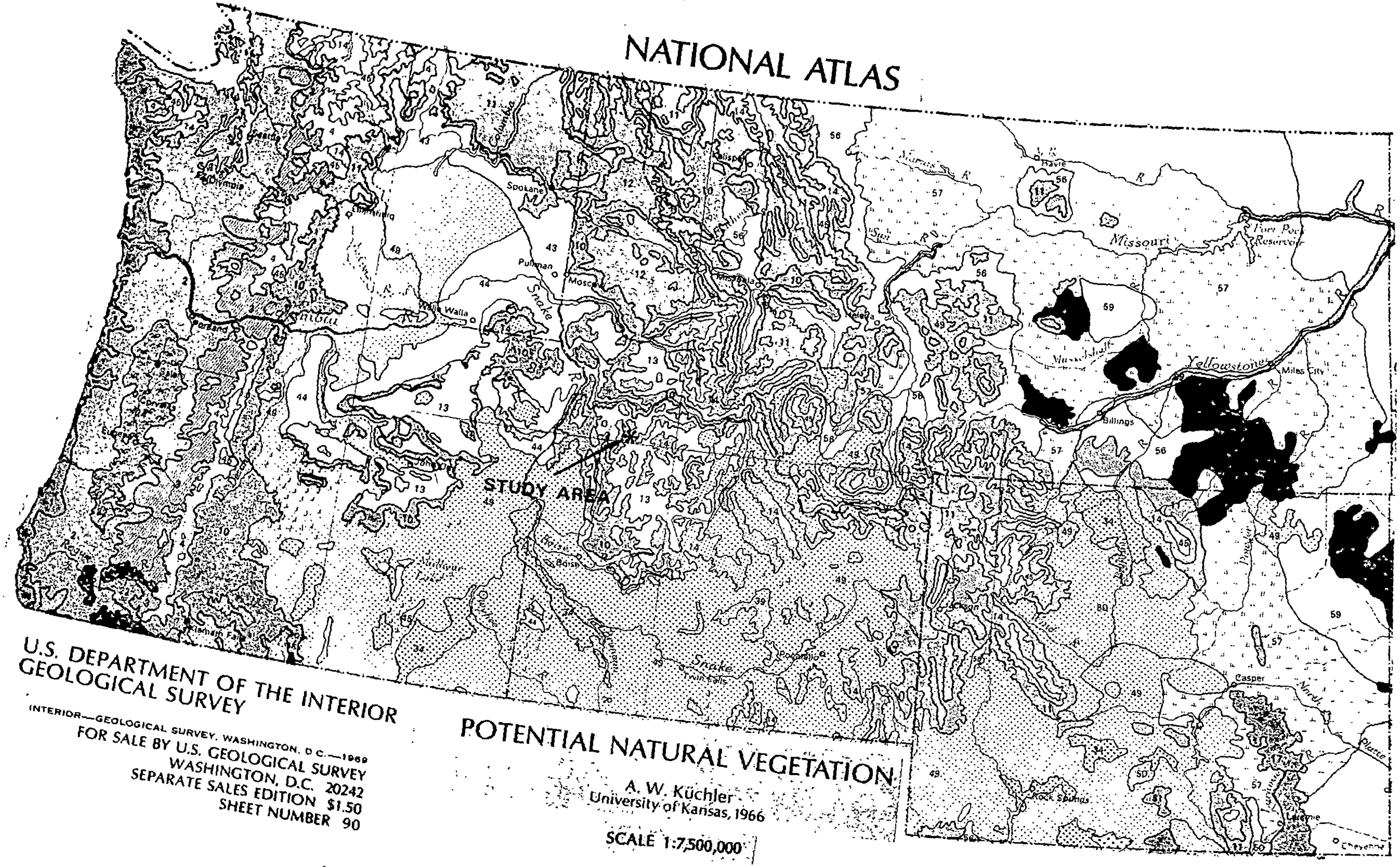

Figure 3.--Potential vegetation of the Pacific Northwest - 1:7,500,000. (Legend on following page.)

WESTERN FORESTS

NEEDLELEAF FORESTS

- 1 Spruce-cedar-hemlock forest *(Picea-Thuja-Tsuga)*
- 2 Cedar-hemlock-Douglas fir forest *(Thuja-Tsuga-Pseudotsuga)*
- 3 Silver fir-Douglas fir forest *(Abies-Pseudotsuga)*
- 4 Fir-hemlock forest *(Abies-Tsuga)*
- 5 Mixed conifer forest *(Abies-Pinus-Pseudotsuga)*
- 6 Redwood forest *(Sequoia-Pseudotsuga)*
- 7 Red fir forest *(Abies)*
- 8 Lodgepole pine-subalpine forest *(Pinus-Tsuga)*
- 9 Pine-cypress forest *(Pinus-Cupressus)*
- 10 Western ponderosa forest *(Pinus)*
- 11 Douglas fir forest *(Pseudotsuga)*
- 12 Cedar-hemlock-pine forest *(Thuja-Tsuga-Pinus)*
- 13 Grand fir-Douglas fir forest *(Abies-Pseudotsuga)*
- 14 Western spruce-fir forest *(Picea-Abies)*
- 15 Eastern ponderosa forest *(Pinus)*
- 16 Black Hills pine forest *(Pinus)*
- 17 Pine-Douglas fir forest *(Pinus-Pseudotsuga)*
- 18 Arizona pine forest *(Pinus)*
- 19 Spruce-fir-Douglas fir forest *(Picea-Abies-Pseudotsuga)*
- 20 Southwestern spruce-fir forest *(Picea-Abies)*
- 21 Juniper-pinyon woodland *(Juniperus-Pinus)*

BROADLEAF FORESTS

- 22 Oregon oakwoods *(Quercus)*
- 23 Mesquite bosques *(Prosopis)*

BROADLEAF AND NEEDLELEAF FORESTS

- 24 Mosaic of numbers 2 and 22
- 25 California mixed evergreen forest *(Quercus-Arbutus-Pseudotsuga)*
- 26 California oakwoods *(Quercus)*
- 27 Oak-juniper woodland *(Quercus-Juniperus)*
- 28 Transition between 27 and 31

- J *Juniperus spp.* (juniper, red cedar)
- S *Sequoia wellingtonia* (giant sequoia)
- Y *Yucca brevifolia* (Joshua tree)

WESTERN SHRUB AND GRASSLAND

SHRUB

- 29 Chaparral *(Adenostoma-Arctostaphylos-Ceanothus)*
- 30 Coastal sagebrush *(Salvia-Eriogonum)*
- 31 Mountain mahogany-oak scrub *(Cercocarpus-Quercus)*
- 32 Great Basin sagebrush *(Artemisia)*
- 33 Blackbrush *(Coleogyne)*
- 34 Saltbush-greasewood *(Atriplex-Sarcobatus)*
- 35 Creosote bush *(Larrea)*
- 36 Creosote bush-bur sage *(Larrea-Franseria)*
- 37 Palo verde-cactus shrub *(Cercidium-Opuntia)*
- 38 Ceniza shrub *(Leucophyllum-Larrea-Prosopis)*

- 39 Desert: vegetation largely absent

GRASSLAND

- 40 Fescue-oatgrass *(Festuca-Danthonia)*
- 41 California steppe *(Stipa)*
- 42 Tule marshes *(Scirpus-Typha)*
- 43 Fescue-wheatgrass *(Festuca-Agropyron)*
- 44 Wheatgrass-bluegrass *(Agropyron-Poa)*
- 45 Alpine meadows and barren *(Agrostis, Carex, Festuca, Poa)*
- 46 Fescue-mountain muhly prairie *(Festuca-Muhlenbergia)*
- 47 Grama-galleta steppe *(Bouteloua-Hilaria)*
- 48 Grama-tobosa prairie *(Bouteloua-Hilaria)*

SHRUB AND GRASSLAND COMBINATIONS

- 49 Sagebrush steppe *(Artemisia-Agropyron)*
- 50 Wheatgrass-needlegrass shrubsteppe *(Agropyron-Stipa-Artemisia)*
- 51 Galleta-three awn shrubsteppe *(Hilaria-Aristida)*
- 52 Grama-tobosa shrubsteppe *(Bouteloua-Hilaria-Larrea)*
- 53 Trans-Pecos shrub savanna *(Flourensia-Larrea)*
- 54 Mesquite-acacia-savanna *(Andropogon-Setaria-Prosopis-Acacia)*
- 55 Mesquite-live oak savanna *(Andropogon-Prosopis-Quercus)*

Figure 3.--(continued) - Legend.

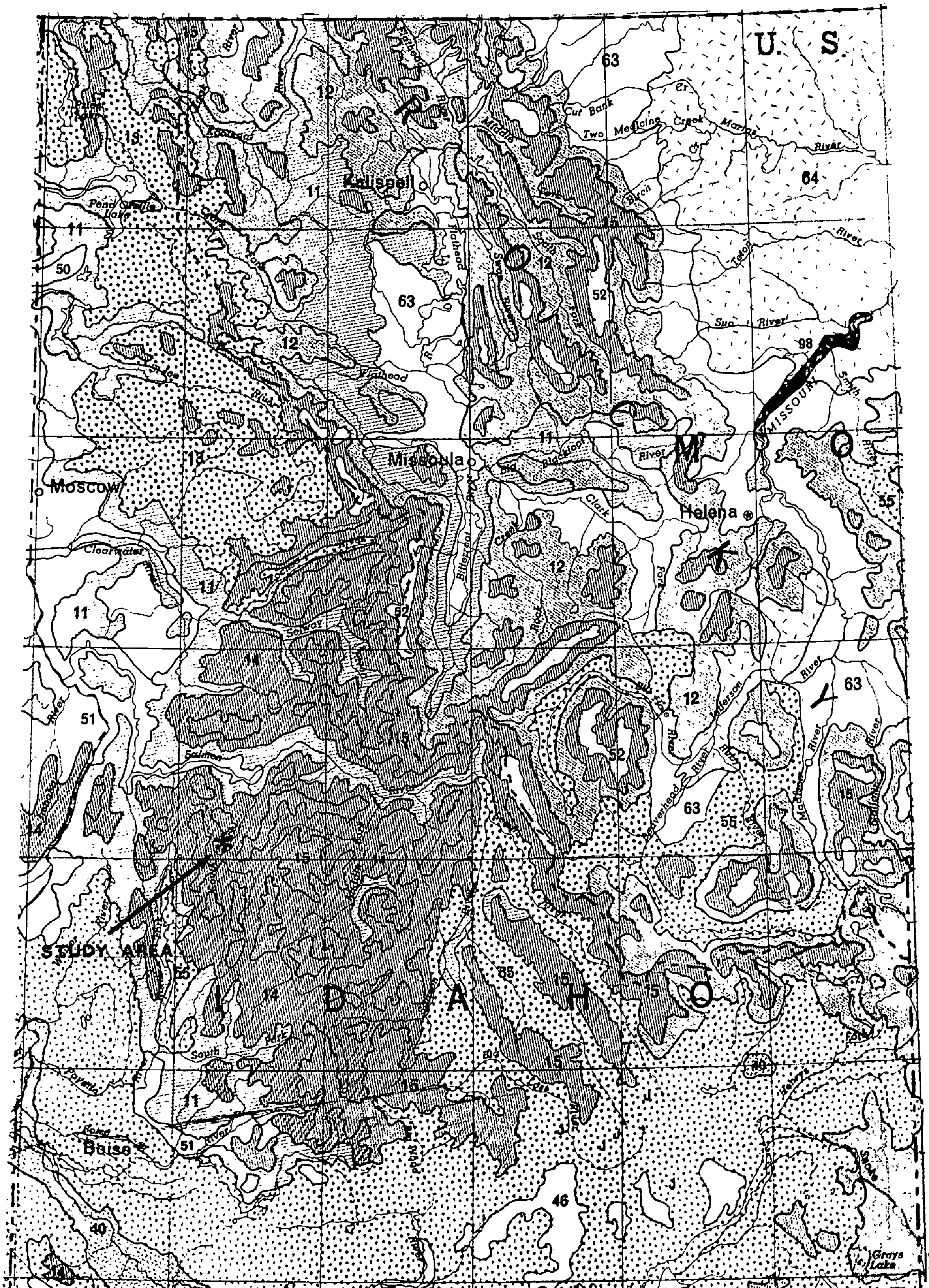

Figure 4.--Potential natural vegetation of Idaho and western Montana, 1:3,168,000. (from Kuchler, 1964; numbers of mapping units are in Table 2)

Table 2.--Representation of Kuchler's potential vegetation types in the Greater Pacific Northwest

Vegetation Types	Oregon Sq. Mi.	Oregon %	Washington Sq. Mi.	Washington %	Idaho Sq. Mi.	Idaho %	Montana Sq. Mi.	Montana %	Wyoming Sq. Mi.	Wyoming %	Sq. Mi.	%
1. Western Forests												
A. Needleaf forests												
1. Spruce-cedar-hemlock forest (Picea-Thuja-Tsuga)	3,175	3.3	3,600	5.5							6,835	1.4
2. Cedar-hemlock-Douglas-fir forest (Thuja-Tsuga-Pseudotsuga)	12,700	13.2	13,266	19.9							25,966	5.3
3. Silver fir-Douglas fir forest (Abies-Pseudotsuga)	5.965	6.2	4,466	6.7							10.431	2.1
4. Fir-hemlock forest (Abies Tsuga)	2,790	2.9	4 933	7.4							7.723	1.6
5. Mixed conifer forest (Abies-Pinus-Pseudotsuga)	1.155	1.2									1,155	0.2
10. Ponderosa shrub forest (Pinus)	8.274	8.6									8,274	1.7
11. Western Ponderosa forest (Pinus)	4.137	4.3		5.6	8,764	10.6	6,261	4.3			22.895	4.7
12. Douglas fir forest (Pseudotsuga)	192	0.2	5,266	7.9	3,720	4.5	21,258	14.6	11,674	12.0	42,110	8.6
13. Cedar-hemlock-pine forest (Thuja-Tsuga-Pinus)					5,705	6.9	1,019	0.7			6,724	1.4
14. Grand fir-Douglas fir forest (Abies-Pseudotsuga)	7,697	8.0			8,350	10.1					16,047	3.3
15. Western spruce-fir forest (Picea-Abies)	577	0.6	3,400	5.1	10,748	13.0	9,901	6.8	6,420	6.6	31,046	6.4
16. Eastern ponderosa forest (Pinus)							7,135	4.9	875	0.9	8,010	1.6
17. Black Hills pine forest (Pinus)									1,946	2.0	1,946	0.4
18. Pine Douglas fir forest (Pinus-Pseudotsuga)									2,724	2.8	2,724	0.6

TABLE 2.--CONTINUED

Vegetation Types	Oregon Sq. Mi.	Oregon %	Washington Sq. Mi.	Washington %	Idaho Sq. Mi.	Idaho %	Montana Sq. Mi.	Montana %	Wyoming Sq. Mi.	Wyoming %	Sq. Mi.	%
22. Great Basin pine forest (Pinus)			67	0.1							67	T
23. Juniper-pinyon woodland (Juniperus-Pinus)					827	1.0			195	0.2	1,022	0.2
24. Juniper steep woodland (Juniperus-Artemisia-Agropyron)	3,945	4.1			1,075	1.3					5,020	1.0
B. Broadleaf forests												
25. Alder-ash forest (Alnus-Fraxinus)	192	0.2									192	T
26. Oregon oakwoods (Quercus)	962	1.0	67	0.1							1,029	0.2
C. Broadleaf and needleleaf forests												
28. Mosaic of numbers 2 and 26	4,329	4.5									4,329	0.9
29. California mixed evergreen forest (Quercus-Arbutus-Pseudotsuga)	96	0.1									96	T
II. Western Shrub and Grasslands												
A. Shrub												
34. Montane chaparral (Arctostaphylos-Castanopsis-Ceanothus)	289	0.3									289	T
37. Mountain mahogany-oach shrub (Cereocarpus-Quercus)									486	0.5	486	0.1
38. Great Basin sagebrush (Artemisia)	192	0.2									192	T
40. Saltbrush-greasewood (Atriplex-Sarcobatus)	3,560	3.7			1,819	2.2			3,891	4.0	9,270	1.9
46. Desert: vegetation largely absent					1,406	1.7					1,406	0.3

TABLE 2.--CONTINUED

VEGETATION TYPES	OREGON Sq. Mi.	OREGON %	WASHINGTON Sq. Mi.	WASHINGTON %	IDAHO Sq. Mi.	IDAHO %	MONTANA Sq. Mi.	MONTANA %	WYOMING Sq. Mi.	WYOMING %	Sq. Mi.	%
B. GRASSLANDS												
50. FESCUE-WHEATGRASS (FESTUCA-AGROPYRON)	192	0.2	6,533	9.8	1,488	1.8					8,213	1.7
51. WHEATGRASS-BLUEGRASS (AGROPYRON-POA)	7,119	7.4	4,600	6.9	2,232	2.7					13,951	2.9
52. ALPINE MEADOWS AND BARREN (AGROSTIS, CAREX, FESTUCA, POA)	481	0.5	2,333	3.5	331	0.4	2,184	1.5	1,654	1.7	6,983	1.4
C. SHRUB AND GRASSLAND COMBINATIONS												
55. SAGEBRUSH STEPPE (ARTEMISIA-AGROPYRON)	28,190	29.3	13,933	20.9	36,212	43.8	3,931	2.7	28,795	29.6	111,061	22.8
56. WHEATGRASS-NEEDLEGRASS SHRUB-STEPPE (AGROPYRON-STIPA-ARTEMISIA)									8,172	8.4	8,172	1.7
III. CENTRAL AND EASTERN GRASSLANDS												
A. GRASSLANDS												
63. FOOTHILLS PRAIRIE (AGROPYRON-FESTUCA-STIPA)							17,327	11.9	292	0.3	17,619	3.6
64. GRAMA-NEEDLEGRASS-WHEATGRASS (BOUTELOUA-STIPA-AGROPYRON)							62,172	42.7	18,775	19.3	80,947	16.6
65. GRAMA-BUFFALO GRASS (BOUTELOUA-BUCHOLE)									4,475	4.6	4,475	0.9
66. WHEATGRASS-NEEDGRASS (AGROPYRON-STIPA)							11,357	7.8	6,907	7.1	18,264	3.7
93. NORTHERN FLOODPLAIN FOREST							3,058	2.1			3,058	0.6
	96,209	100	66,257	100	83,677	100	145,603	100	97,281	100	488,027	100

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APPENDIX B

THE LAND SYSTEM

APPENDIX B - THE LAND SYSTEM

Land--a portion of the earth's surface--is a primary component of ECOCLASS. Soils, geology and landform are land elements that relate well to the Vegetation and Aquatic Systems. Land-use planning must encompass the understanding of these relationships and provide methods by which renewable resources can be used while preserving the physical and biological potential of the land base.

Many land classification systems have been proposed. Some have been merely descriptive of the land itself without recognition of its physical and biological relationships and potentials. Others have been interpretive, single objective classifications or inventories which have not been adaptable for multipurpose land use planning.

In the ECOCLASS method the Land System permits recognition of units which are real bodies in nature and can be delineated. The character of these units depends upon land forming processes. A variety of interpretations relating to land capability and limitations can be made for each unit. Interpretations are more generalized in higher levels of the System and most specific at the Landunit level. Land use planning determines how these facts about the location, character and productivity of the lands are applied in a management situation.

As noted in Figure 5, the primary basis for class definition is in terms of basic (independent) and manifest (dependent) components. The interaction between basic components of structure and lithology, process, and climate over time are best expressed in the first three Land System levels: Province, Section and Subsection. Landtype association, Landtype and Landunit represent an increasing expression of the manifest components. Landunit, although representing a specific combination of structure, process and time is more precisely described as the expression of manifest components of soils, landform, and biotic influence.

The six levels of the Land System are shown in Table 3. This System has been developed in the Northwestern United States more or less individually (1) (2) (3). However, it has many common links with systems developed in other countries. An excellent review of these systems has been prepared by Australians Christian and Stewart (4). Of particular significance is the similarity of the Land System of ECOCLASS to that developed by Nakano (5) which describes 5 strata. However, ECOCLASS is unlike many other systems in that at the lowest strata, one or more Landunits can occur on one landform. This system permits the greatest possible flexibility and management significance. If the Landunit does not have management significance, it is not mapped. Such a versatile system also relates well to the linkage with the Vegetative and Aquatic Systems in the recognition of discrete Ecological Land Units and Ecological Water Units.

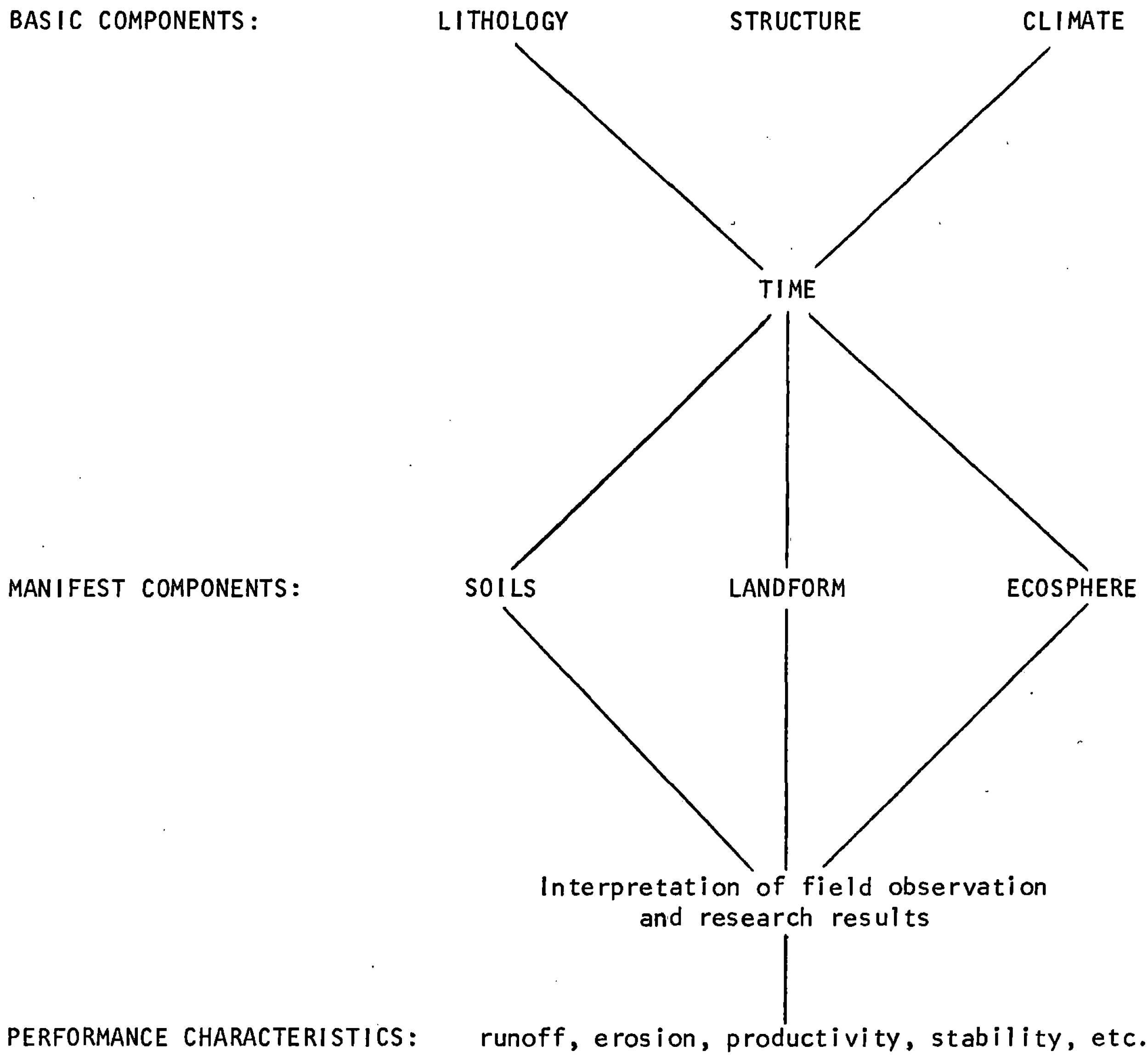


Figure 5.--Relationship of Basic and Manifest Components to Land System Performance.

Table 3.--Characteristics of the six levels of the Land System

Name	Dominantly expressed Components	Size Range	Principal Application
Physiographic Province	Basic Components. Structure, process, time. First order stratification of basics.	1000s of sq. miles	Nationwide, broad regional.
Section	Basic Components. Structure, process, time. Second order stratification of basics.	100s to 1000s of sq. miles	Broad regional.
Subsection	Basic Components. Structure, process, time. Third order stratification of basics.	10s to 100s of sq. miles	Long term resource allocation (Regional).
Landtype Association	Manifest Components dominate but Basic Component influence remains strong. Soil-landform-biotic influences stronger than process, structure, and time factors.	1 to 10s of sq. miles	Long or intermediate term resource allocation, Region or National Forest.
Landtype	Manifest and Basic Components. Second order stratification of manifest components.	1/10 to 1 sq. mile	Multiple use plans, Forest transportation system plan. Range allotments, Forest timber management plans.
Landunit	Manifest and Basic Components. Third order stratification of manifest components.	1/100 to 1/10 sq. mile	Project plans.

The Landunit shown in Table 3 is composed of one or more smaller units which are recognizable "on the ground." These small units are not useful in most applications of areal land use planning, but each might be properly considered in a specific site plan such as a landscaping plan for a dwelling or campsite or for logging engineering purposes such as design of a logging landing area. Such a "site" is the expression of manifest components occupying less than an acre area and not generally considered mappable on an extensive project basis. Segments of a "site" may be composed of individual soil-sites called "pedons" (6). These may measure as little as several square feet of land area. These small segments are an ultimate expression of manifest components and give insight to the fundamental biotic-abiotic relationships needed for research purposes and for definition of broader units described in the Land System.

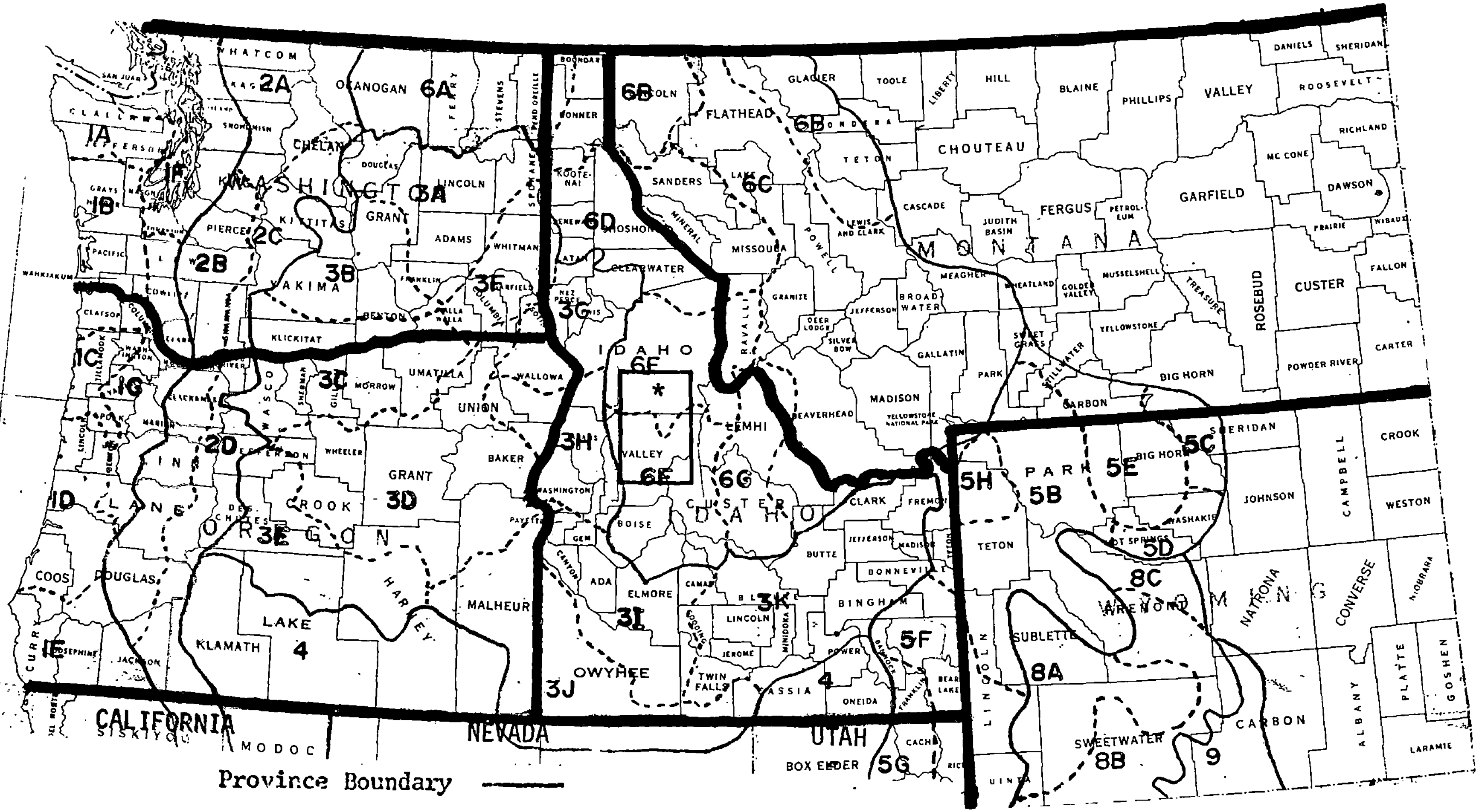
The taxonomic classification of the National Cooperative Soil Survey (NCSS) (6) may be used to describe soils of the Land System mapping units. The soil portion of the Landtype has usually been characterized at the Family level of the NCSS classification. For the Landunit, soils are characterized at the Series level or at the Phase level of the NCSS classification. Soils play only a part in the delineation of boundaries of the Land System units. Therefore, Land System mapping boundaries may not coincide with NCSS mapping boundaries.

STATUS OF CLASSIFICATION AND MAPPING

Province, Section and Subsection maps are available for the Pacific Northwest (Figures 6, 7, and 8). Certain areas of U.S. Forest Service Regions 1, 2, 4, and 6 have Landtype and Landtype Association classification and mapping as illustrated in Figure 9. Regions 1, 4, and 6 will have this task completed by 1977. Landunits (or Landtype Phases as termed in Region 4) have been classified and mapped on small areas in Regions 1, 2, 4, and 6 as illustrated in Figure 10. However, this task is extremely time-consuming and with present financing and goals, this work will not be completed within 40 years in the Pacific Northwest.

Figure 6.--Physiographic provinces of the United States - 1:15,000,000. (from Hunt, 1967)

PHYSIOGRAPHIC PROVINCES A ECTIONS OF THE NORTHWESTERN STATES



Province Boundary ———

Section Boundary - - -

Study Area *

Figure 7.--Physiographic provinces and Sections of the Northwestern States - 1:7,500,000. (Legend on following page.)

PACIFIC BORDER PROVINCE

1A Olympics
1B Willapa Hills
1C Tillamook Uplands
1D Siuslaw Uplands
1E Klamath - Siskiyou
1F Puget Sound Basin
1G Willamette Basin

SIERRA CASCADE PROVINCE

2A Northwestern Cascades
2B Western Cascades
2C Northeastern Cascades
2D High Cascades

COLUMBIA PLATEAU PROVINCE

3A Channeled Scablands
3B Yakima-Kittitas
3C Umatilla Breaks
3D Blue Mountains
3E Harney High Lava Plain
3F Palouse Hills
3G Tristate Uplands
3H Wallowa-Seven Devils
3I Malheur-Boise-King Hill
3J Malheur-Owyhee Uplands
3K Eastern Snake River Plain

4 BASIN AND RANGE PROVINCE

MIDDLE ROCKY MOUNTAIN PROVINCE

5A Yellowstone Plateau
5B Yellowstone Mountains
5C Bighorn Mountains
5D Oal Creek Range
5E Bighorn Basin
5F Wyomide Ranges
5G Wasatch Range
5H Uinta Range

NORTHERN ROCKY MOUNTAIN PROVINCE

6A Okanogan Uplands
6B Northern Trench
6C Northern Rockies Basin Range
6D Coeur d'Alene
6E Salmon Uplands
6F Southern Batholith
6G Challis-Pioneer

7 GREAT PLAINS PROVINCE

WYOMING BASIN PROVINCE

8A Green River - Red Desert Basins
8B Rock Springs - Granite Highlands
8C Wind River Basin

9 SOUTHERN ROCKY MOUNTAIN PROVINCE

Figure 7.--(continued) - Legend.

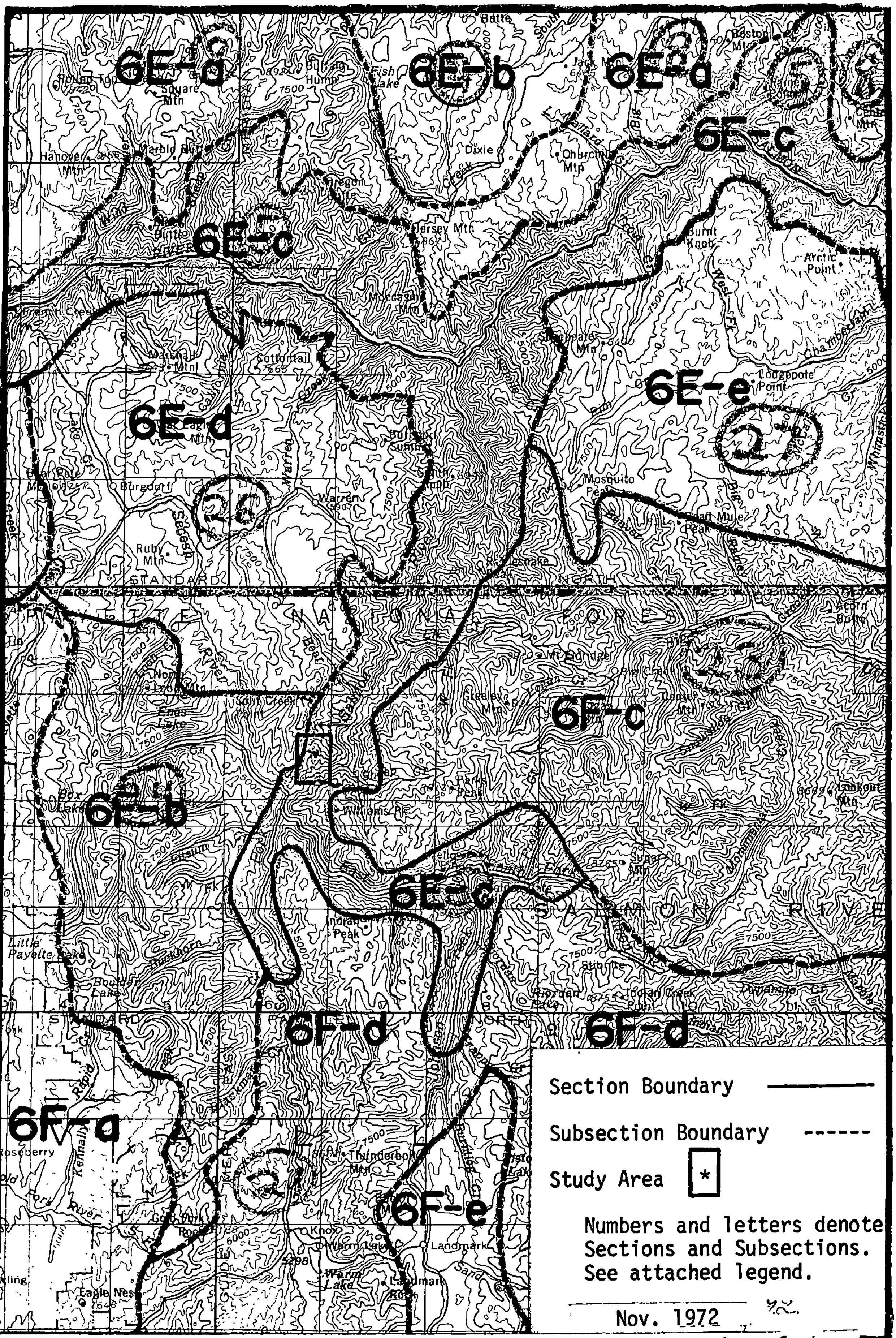


Figure 8.--Physiographic Sections and Subsections for a portion of the Northern Rocky Mountain Province - 1:500,000. (Legend on following page.)

SECTIONS AND SUBSECTIONS IN A PORTION OF THE NORTHWEST ROCKY MOUNTAIN PROVINCE

6 E - Salmon Upland Section

a. Red River Nivational Plateau Lands

b. Elk City Nivational Plateau Lands

c. Salmon River Canyon Lands

d. Burgdorf Basin Lands

e. Chamberlain Basin Lands

6 F - Southern Batholith Section

a. Long Valley Section

b. Payette Glaciated Lands

c. Steep Uplifted Maturely Dissected Rejuvenated Lands

d. South Fork Salmon Alpine Glaciated and Stream Cut Lands

e. Bear Valley, Landmark, Stanley Basin Lands

Figure 8.--(continued) - Legend.

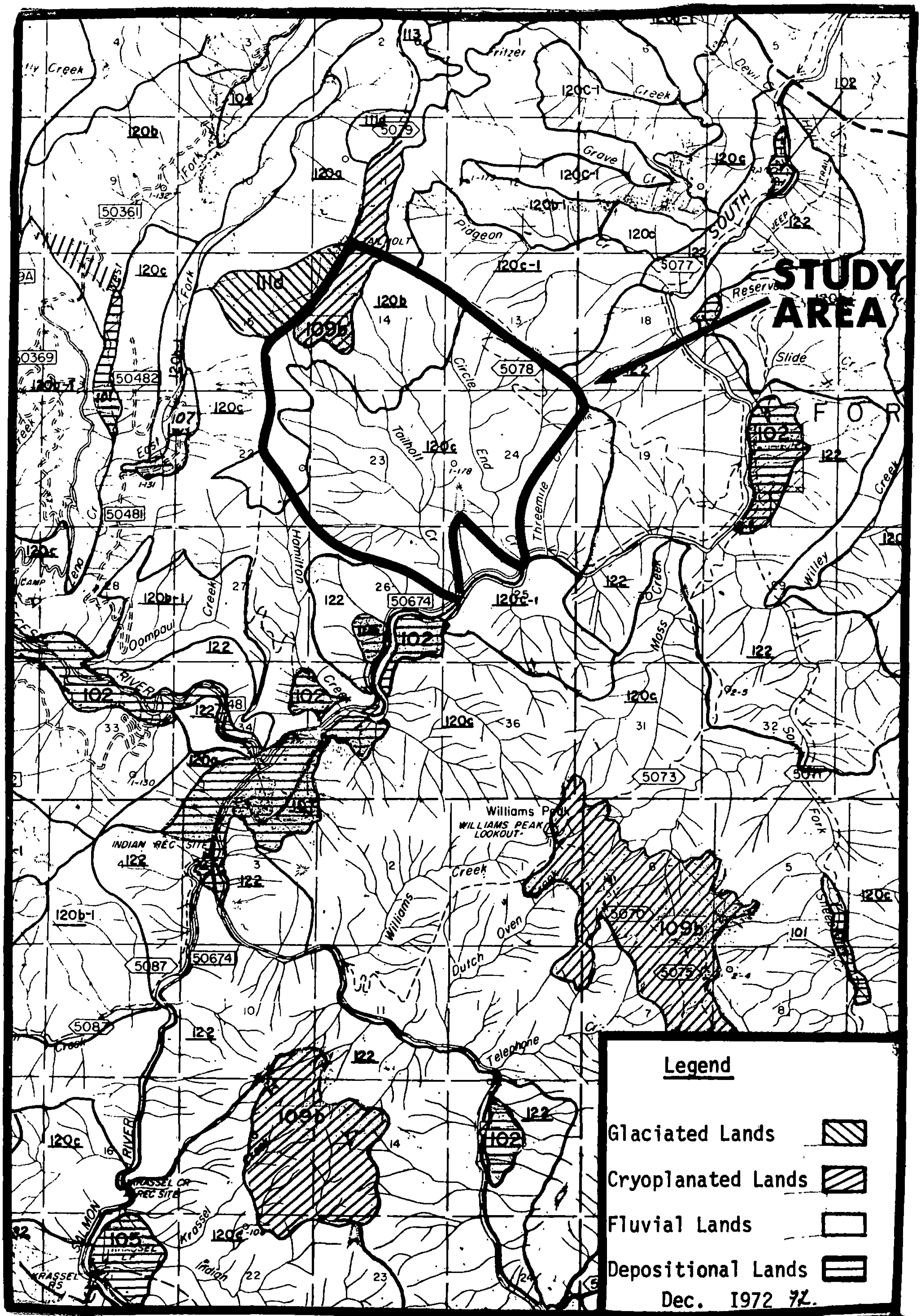
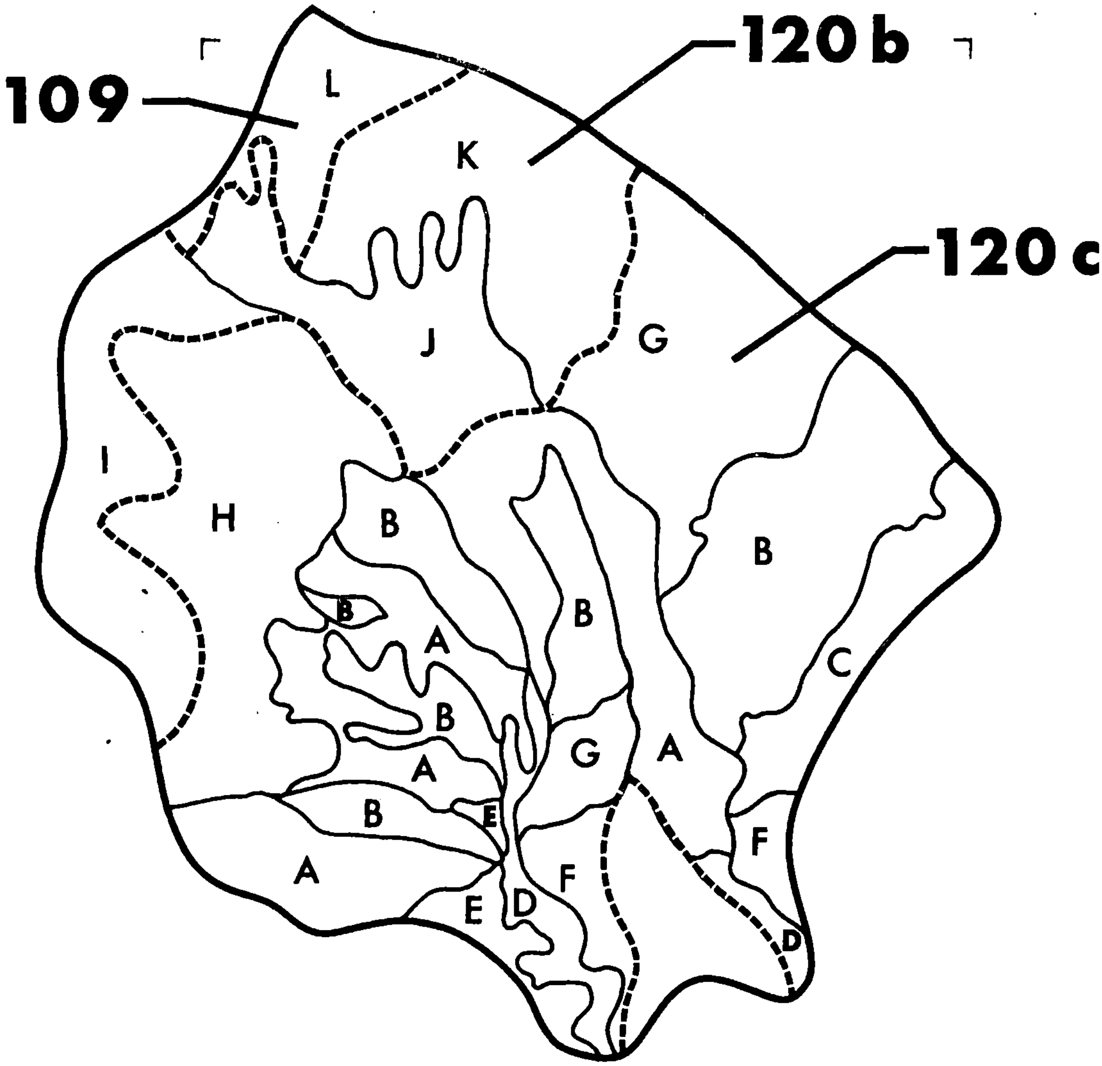


Figure 9.--Landtype Associations and Landtypes for a portion of the Salmon River Canyon Subsection - 1:63,360 or 1"/mile.



LAND TYPE & LAND TYPE PHASE

109 (Cryoplanated Uplands)

120 b (Mtn. Slope – mod. dissected)

120 c (Mtn. Slope – strongly dissected)

A-L (Land Type Phases)

Figure 10.--Landtypes and Landtype Phases in Tailholt and Circle End Creeks - 1:31,680 or 2"/mile.

LAND SYSTEM REFERENCES

1. Alvis, R. J.
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APPENDIX C

THE AQUATIC SYSTEM

APPENDIX C - THE AQUATIC SYSTEM

Many different systems have been presented through the years for classifying aquatic environments. Usually the systems pertained only to certain types of environments, such as lakes, or were too general to be of value for management purposes. The systems varied as to the factors used to classify the different types of environment. Some used chemical properties, other used certain physical properties, and still others used biological properties. The combination of properties needed to classify aquatic types in the Pacific Northwest had not been worked out. This report outlines an attempt to develop an aquatic ecosystem classification that will be of value in the resource manager's planning and administrative processes.

PROPOSED AQUATIC CLASSIFICATION SYSTEM

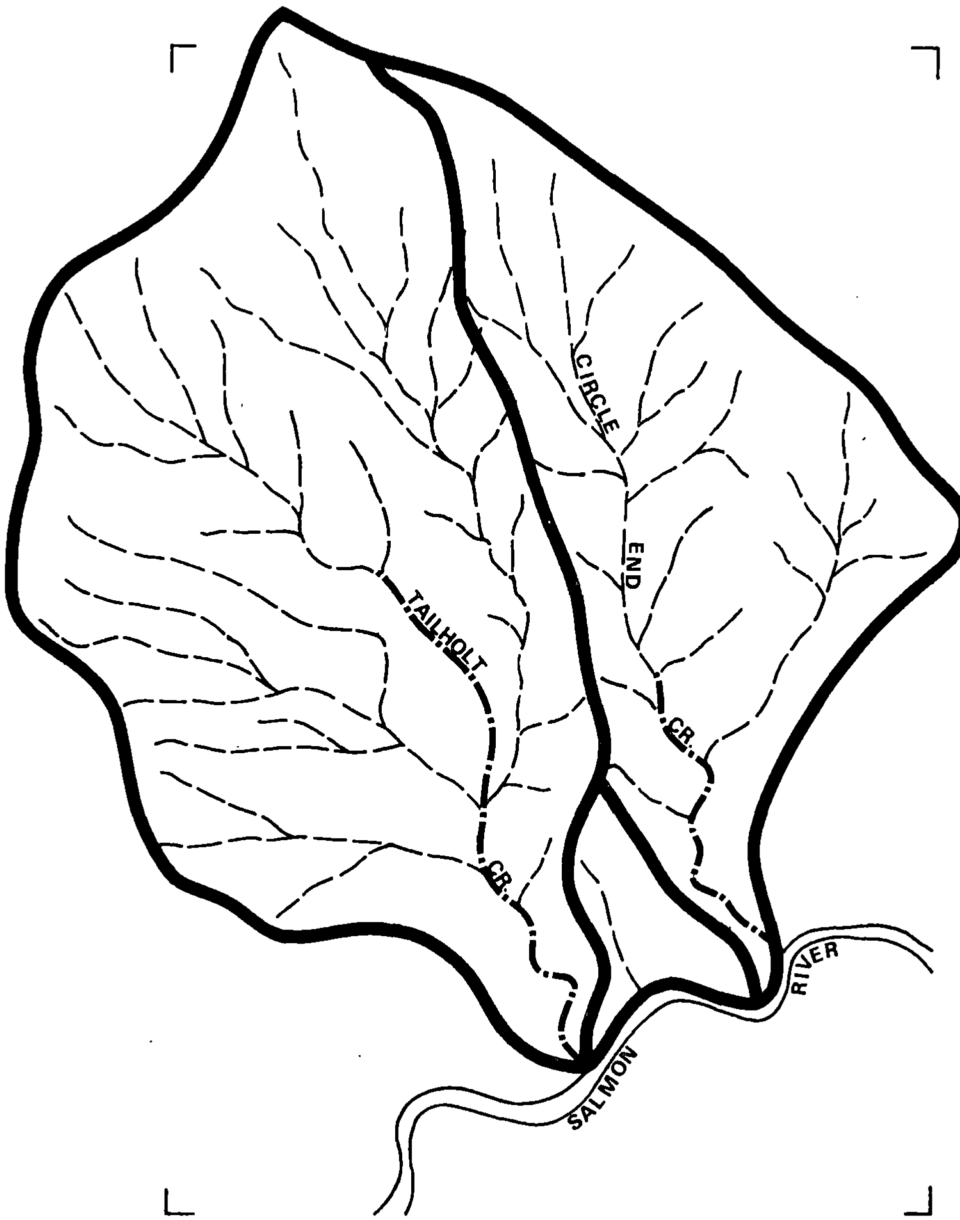
The proposed classification system (page 9 in main report) stresses the taxonomic relationship of aquatic environments based on their capability, limitation and response to produce goods and services. This system outlines levels that range from broad general grouping of aquatic environments down to the more definite Aquatic Types. Aquatic environments in the Pacific Northwest differ from those in the southeastern U.S. For example, the Alsea River in Oregon and the Quachita River in Arkansas are similar in some respects, but their water temperatures allow differentiation at the Aquatic Family level. Local geographic relationships are stressed at the Aquatic Type Association level. Gradient differences are one criteria that enable differentiation at the Aquatic Type level on the same stream. For example, Circle End Creek, a small tributary of the South Fork of Salmon River has two aquatic types (Figure 11).

Although the Aquatic Type is the lowest classification level, Aquatic Site information such as a spawning riffle, a falls, or a log jam is an important consideration in management and detailed planning. A group of interrelated sites make up the Aquatic Type; thus, although planning and management is usually at the Aquatic Type level, Aquatic Sites are identified where special management consideration is needed.

Aquatic Type and Aquatic Type Associations are most useful to the resource manager. At these levels, information is sufficiently specific and the units are small enough to expect demonstrable results from management programs. Higher levels of classification at Aquatic Family, Aquatic Class and Aquatic Order will be successively more general. These general levels will be adequate for broad planning but will lack detail for management purposes.

RELATIONSHIP TO LAND AND VEGETATION CLASSIFICATION SYSTEMS

An understanding of the interrelationship of Land, Vegetation and Aquatic Systems is essential for the resource manager. Because water



AQUATIC TYPES

- - - Steep Fluvial Headwaters Stream
—·— Steep Fluvial Small Stream
≈ Canyon River

Figure 11.--Aquatic Types in Tailholt and Circle End Creeks - 1:31,680 or 2"/mile.

was a major factor in forming the landscape (landtypes, soils, etc.) and determines in large part the kind of vegetation, it seems logical that there are definite relationships among the systems that make up the entire ecosystem. Water flowing over land dissolves minerals that are basic in biological processes. On the other hand, large amounts of suspended sediment can limit photosynthesis and reduce habitat for aquatic animals. Terrestrial vegetation contributes energy to biological productivity through leaves and animals falling into the water. However, large amounts of terrestrial vegetation can reduce dissolved oxygen and limit biological production. Thus, the resource manager must understand what is happening to the land and vegetation if he is to manage the aquatic environment.

The concept of the Ecological Water Unit is proposed in the ECOCLASS method. EWU's have not been used for any actual planning area as of this date. However, it is essential that this concept be emphasized and explored because of the dominant influence of land and vegetation on the aquatic ecosystems.

Because water is fluid, and so is much of the streambed (bedload) during floods, upstream conditions determine to a large degree the characteristics of the aquatic environment at any point in a stream. A point far upstream near the source is affected more by contiguous land and vegetation than by upstream water conditions. As distance downstream increases (and stream size increases) contiguous land and vegetation become less influencing and upstream water conditions become the major factor influencing aquatic environments. Lakes and marshes are influenced also by upstream conditions, but contiguous land and vegetation frequently play the major roles in determining biological productivity. Estuaries are influenced primarily by upstream characteristics intermingling with ocean characteristics.

CIRCLE END CREEK EXAMPLE

Circle End Creek, a tributary of the South Fork of the Salmon River, has been chosen to illustrate the concept of ECOCLASS (Figure 11). The creek can be related to the proposed classification scheme (page 9 in main report) to show how it fits into the various levels. Two Aquatic Types are found in Circle End Creek (steep, fluvial, headwaters stream; steep, fluvial, small stream). These Aquatic Types are grouped with similar adjacent waters forming Tailholt-Circle End Creeks Aquatic Type Association (Dissected Mountain streams). Circle End Creek can also be related to the Aquatic Family level (Cold Streams), to the Aquatic Class (Streams), and to Aquatic Order (Freshwater).

In a functional survey of Circle End Creek, we note Aquatic Sites important to management of the stream such as spawning riffles and the

dam and bed-load measuring basin near the mouth of the stream. Only the most important Aquatic Sites are normally noted because much money and time is required to inventory at this level. It is often more detailed than needed for management purposes, too, because many of the Aquatic Sites are somewhat similar to others upstream and downstream. All pools and riffles in a particular stream may be influenced by one particular activity in the headwaters. Thus, it is frequently convenient to think of a drainage, like Circle End Creek collectively as an Aquatic Type, or if the drainage is relatively diverse, as an Aquatic Type Association. Another possibility is to group adjacent small drainages as an Aquatic Type Association, as we have done for Tailholt and Circle End Creeks (Figure 11).

Both Aquatic Types have a steep gradient and similar chemical properties; they differ in that the steep, fluvial, headwater stream (Aquatic Type) is too steep and small for fish, whereas the steep, fluvial, small stream (Aquatic Type) is of lesser gradient, slightly larger, and supports fish.

Tailholt Creek and Circle End Creek are examples of Dissected Mountain Streams (Aquatic Type Association) commonly occurring in the Salmon River Canyon Subsection of the Land System (Figure 9). This combination constitutes an Ecological Water Unit at the Aquatic Type Association-Subsection levels (Figure 1 of main report).

Description

The description of Circle End Creek as it would be done in applying ECOCLASS follows:

> The small stream lies mainly in strongly dissected mountain slope lands (Landtype 120c - Figure 10) with the headwaters stream in moderately-dissected mountain slope lands (Landtype 120b - Figure 10). Mean elevation is 5,645 feet with dominant orientation south, southeast. The drainage area is 1.45 square miles. Mean low flow os 0.3 cfs; mean high flow os 4.8 cfs. The stream has a mean annual sediment yield of 14.4 yd^3/mi^2, which is high for streams in dissected mountains. The stream has a high gradient (9%) and high sediment transport capacity. The well-vegetated streambanks are stable, and provide excellent cover for fish. A summary of the physical and hydrochemical characteristics of the stream is found in Table 4.
>
> Temperatures range from 33°F in January to 63°F in July, which are suitable for salmanids. The stream is relatively infertile (hardness 36 ppm and NO_3 0.25 ppm), although it is more fertile than the South Fork Salmon River that it empties into. This stream is representative of streams in dissected mountain slope

Table 4.--Physical and hydrochemical characteristics of Circle End Creek South Fork Salmon River, Idaho

Item	Value
Stream width	3 feet
Stream depth	3 inches
Riffle: Pool ratio	65:35
Pool rating	5 (shallow & small)
Stream bottom composition (%)	
Boulders	21
Rubble	5
Gravel	9
Fines	65
Streambank cover	1.5 (Provides good shade and cover for fish)
Streambank condition	2.0 (Very stable)
Streambank type	2.0 (Well protected by brush and sod)
Turbidity	3 ppm
Total solids	90 ppm
Total dissolved solids	77 ppm
Alkalinity	30 ppm
Hardness	36 ppm
Nitrate (NO_3)	0.25 ppm
Phosphorous (P)	0.03 ppm
Heavy metals	Each <0.010 ppm

lands (120 Landtypes), except that the amount of fines in the channel are much higher than expected with the soils that are present.

Cutthroat and rainbow trout are the only fish species present and the standing crop is low. Average numbers are 2.3 cutthroat and 1.0 rainbow/1000 ft^2. Adult trout reach a size of 6-7 inches in length and the fish collected (all age classes) average 2.2 inches.

Interpretations

Capability and response.--The best use of this stream and other similar Aquatic Types in this Aquatic Type Association is to supply high quality water and to serve as a spawning and nursery area for anadromous steelhead and resident cutthroat trout from the South Fork of Salmon River. The high gradient (9%), poor pool structure (rating 5), and small stream size limits size of resident fish. Consequently, it supports virtually no on-site fishing. Removal of the dam at the mouth would make spawning area available for approximately 20 pairs of cutthroat and 5 pairs of steelhead.

Limitations.--The chief limitation to the stream serving as a spawning and nursery area for steelhead and cutthroat is the experimental dam and bed-load catch basin at the mouth that blocks upstream fish migration. The recommended restrictions on land management activities to maintain and enhance stream quality are:

1. Should not increase summer water temperature over 2°F. This would still provide good temperature for salmonids; greater increases would approach the critical range.

2. Should save shading vegetation on both sides of the stream because of its south, southeast orientation.

3. Should not increase sediment yield because it is already high.

ADDITIONAL CONSIDERATIONS

Although the thrust of the aquatic part of ECOCLASS has initially emphasized fish producing waters and tributaries that influence these waters, the responsibility for including wildlife that are a part of the aquatic environment is recognized. Otters, beavers, muskrats, ouzels and all kinds of waterfowl must be considered. These animals are part of the scene on lakes and streams, but perhaps the richest of the environments for aquatic wildlife are the estuaries and marshes, especially for waterfowl and certain other birds.

The importance of esthetics must also be recognized. Factors that degrade the esthetic quality of water are, of course, a limitation to the recreational use of that water. The same may be said for changes that impair the use of water for domestic and industrial purposes.

STATUS OF THE AQUATIC SYSTEM

This task force provided the opportunity to propose a new Aquatic Classification System. Most bodies of water are mapped as a part of basic cartographic information. However, we have not had a uniform classification system for characterizing and communicating clearly about aquatic ecosystems, especially to the numerous disciplines that directly or indirectly affect the aquatic resources. Following review and additional experience with the proposed system, revisions can be made to finalize the Aquatic System classification.

APPENDIX D

THE TAILHOLT-CIRCLE END EXAMPLE

APPENDIX D--THE TAILHOLT-CIRCLE END EXAMPLE

The main purpose of this example is to demonstrate the methodology of using the ECOCLASS method to map permanent characteristics of ecosystems. In management planning this is only one of the steps. Before elaborating on the description of the mapping units and the interpretations of these characteristics, management objectives need to be established. This is the stage in the planning process where the study teams need to specify the kind and accuracy of information desired from the ecosystem classification. Since this example is not tied in to the planning process, it will be used only to illustrate the scale of two lower levels of the Vegetation, Land, and Aquatic Systems and the overlay method of linking the Systems together.

Tailholt Creek and Circle End Creeks (Figure 11), on the South Fork of the Salmon River were selected to illustrate the ECOCLASS method of permanent ecosystem classification, because other areas were unavailable in early 1972 that had been mapped to the lower levels of the three ECOCLASS Systems (Vegetation, Land, and Aquatic). This area had been previously mapped to the Landtype Phase level and data had been collected on the Aquatic Types. Completion of a Habitat Type map during the summer of 1972 provided the final mapping input. Since this data was collected independently, it offered a good opportunity to overlay the independent maps and compare the distribution of the various mapping units.

THE VEGETATION SYSTEM

A Habitat Type classification does not exist for central Idaho, although a current cooperative study should provide a preliminary classification by June 1973. Based on northern Idaho Habitat Types and some ideas from the current central Idaho study, tentative Habitat Types were defined and mapped on a 4"/mile topographic map. Four Series and seven tentative Habitat Types were mapped for the 2,500-acre area (Figure 12). Only two of the Habitat Types were common with previously described northern Idaho types. Therefore, management implications are limited to qualitative evaluation of observations and meager data collected during three days of field mapping. The Habitat Type definitions and the implications for management (as described in Appendix A) will be firmed up considerably following completion of the preliminary Habitat Type classification for central Idaho in June 1973.

THE LAND SYSTEM

Three Landtypes and twelve Landtype Phases were identified and mapped in 1969.[5] Descriptions for the Landtype Phases are considerably more

[5] Clayton, James L. and Kermit N. Larson. 1969. Soil, vegetation, and hydrologic survey of Tailholt and Circle End Creeks. U.S. Forest Serv., Region Four. Mimeographed office report and map, 25 p.

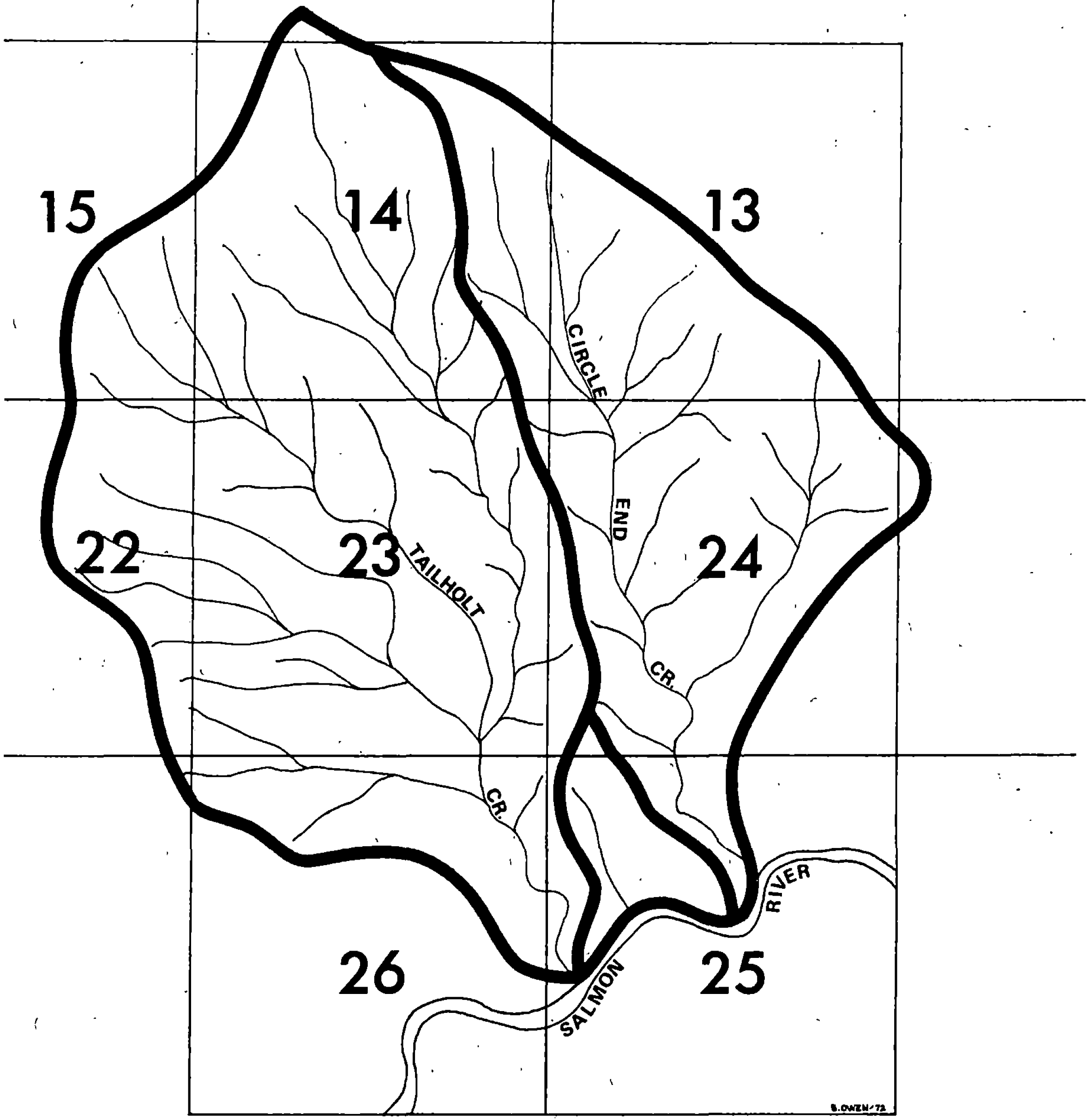


Figure 12.--Base Map for Tailholt and Circle End Creeks - 1:31,680 or 2"/mile.

precise and allow greater precision in developing management implications, than at the Landtype level. Within the Landtype Phases, soils are described to the Series level of the National Cooperative Soil Survey classification system. Relative extent of each soil and location within the mapping unit is known as well.

THE AQUATIC SYSTEM

Three aquatic units were mapped as shown in Figure 11. Description of the Aquatic Types and interpretations for management are presented in considerable detail in Appendix C.

ECOLOGICAL WATER UNITS

Overlaying the Aquatic Type map (Figure 11) with the Landtype Phase map (Figure 10) provides several possible Ecological Water Unit combinations. The most useful Ecological Water Units for a planning area of this size are probably the following:

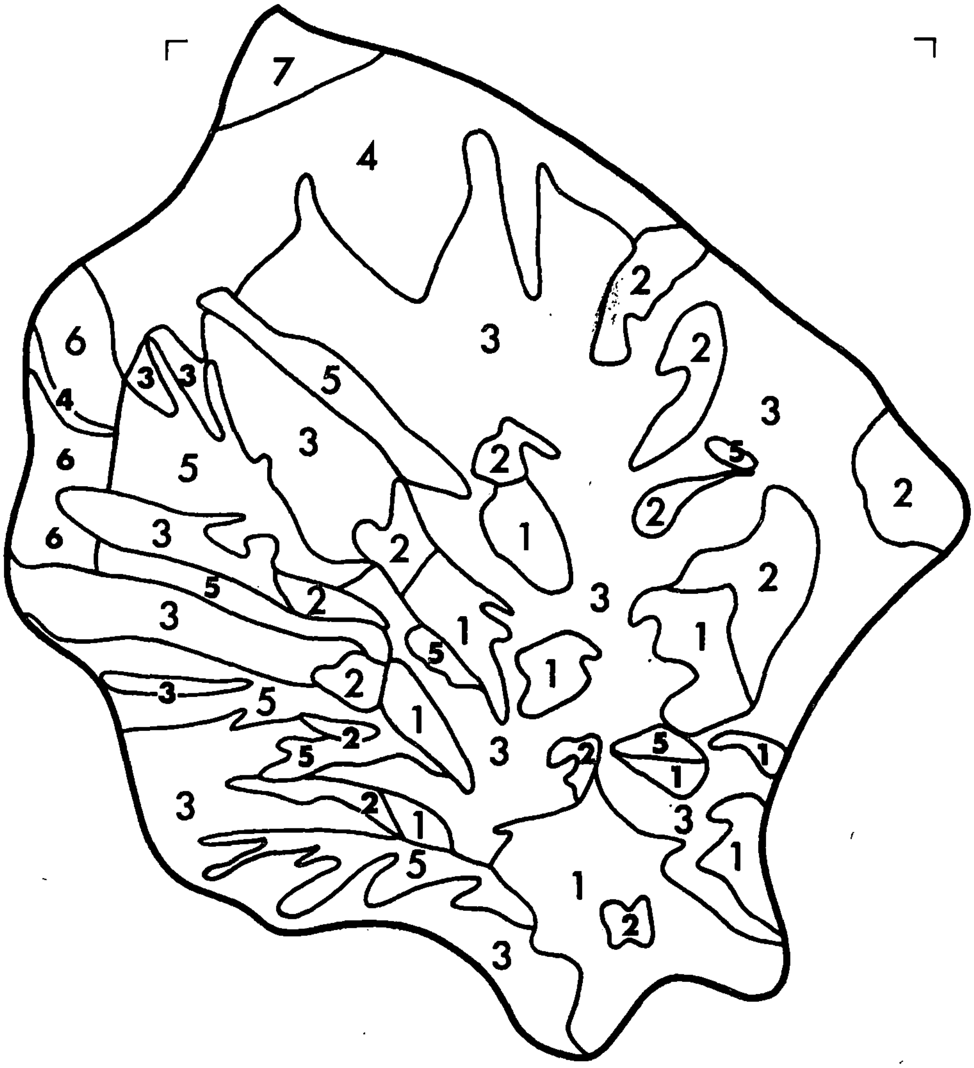
Landtype 120b	-	headwaters Aquatic Type
Landtype 120c	-	headwaters Aquatic Type
Landtype 120c	-	small stream Aquatic Type
Fluvial Landtype Association	-	Dissected Mountain Stream Aquatic Type Association
Salmon River Canyon Subsection	-	Canyon River Aquatic Type Association

Numerous other EWU combinations could be made at the Landtype Phase-Aquatic Type level. Description of these combinations would be useful primarily for detailed project planning. Combinations with the Vegetation System can also be made if necessary for particular planning objectives.

THE ECOLOGICAL LAND UNITS

This example provides the opportunity to explore the possibilities of Ecological Land Unit characterization. By overlaying the Habitat Type Map (Figure 13) with the Landtype and Landtype Phase map (Figure 10), we have an unbiased approximation of all possible combinations within the study area of the Land System units with the Vegetation System units.

Starting at the lowest level of the classification, we have 12 Landtype Phases and 7 Habitat Types (Table 5b). The number of possible combinations (7 x 12) is thus 84, if the Systems were completely independent. Actually, there is some degree of correlation because only 38 combinations were found. Combinations representing very small acreages may be due to inaccuracies of mapping or limited areas of such



HABITAT TYPES

- [1] PP/ Purshia tridentata
- [2] DF/ Symphoricarpos – Spiraea
- [3] DF/ Physocarpus malvaceus
- [4] DF/ Symphoricarpos – Carex
- [5] GF/ Vaccinium membranaceum
- [6] AF/ Vaccinium membranaceum
- [7] AF/ Carex geyerii

Figure 13.--Habitat Types in Tailholt and Circle End Creeks - 1:31,680 or 2"/mile.

small extent to be of little significance for management planning. Elimination of units representing less than 20 acres results in a total of 27 Ecological Land Units.

Other levels of Ecological Land Units are also illustrated in Table 5b. Defining ELU's at the Habitat Type-Landtype level (Table 5b) would result in a potential of 7 x 3 = 21 combinations. In actuality only 12 ELU's are shown and only 10 of these represent more than 20 acres. At the Series-Landtype Phase (Table 5c) level we have a potential of 4 x 12 = 48 combinations. However, we had only 28 ELU's and only 20 of these represent more than 20 acres. At the Series-Landtype level (Table 5d), we have 4 x 3 = 12 possible combinations. A total of 9 ELU's are characterized, 8 of which represented more than 20 acres.

By elimination of minor acreages (<20 a.) attributable to possible mapping errors, the number of Ecological Land Units for the four combinations can be summarized briefly:

a. 7 Habitat Types - 12 Landtype Phases - 27 ELU's
b. 7 Habitat Types - 3 Landtypes - 10 ELU's
c. 4 Series - 12 Landtype Phases - 20 ELU's
d. 4 Series - 3 Landtypes - 8 ELU's

These alternatives illustrate the flexibility of the ECOCLASS method in providing levels of stratification and information for planning purposes. The aggregation upward provides less detail, but simplifies the interrelationships and reduces the resultant number of units to work with. The choice of levels to use depends on the detail needed to meet planning needs objectives and the resources available to provide the stratification and interpretations.

Table 5 .--Ecological Land Units of Tailholt a Circle End Creeks. Acreages are shown by units for four possible combinations of Vegetation and Land Systems

a. Habitat Type--Landtype Phase

Landtype Phase	Habitat Type 1	2	3	4	5	6	7	Total
A	25	33	266	-	108	-	-	432
B	133	120	165	-	5	-	-	423
C	8	22	67	-	-	-	-	97
D	17	-	42	-	8	-	-	67
E	-	-	47	-	2	-	-	49
F	62	-	6	-	-	-	-	68
G	-	70	190	14	1	-	-	275
H	-	2	184	6	126	10	-	328
I	-	-	50	31	33	74	-	188
J	-	-	107	52	26	-	-	185
K	-	-	109	140	-	-	-	249
L	-	-	-	67	-	-	31	98
Total	245	247	1233	310	309	84	31	2459

b. Habitat Type--Landtype

Landtype	Habitat Type 1	2	3	4	5	6	7	Total
120c	245	247	967	20	250	10	-	1739
120b	-	-	266	223	59	74	-	622
109	-	-	-	67	-	-	31	98
	245	247	1233	310	309	84	31	2459

c. Series--Landtype Phase

Landtype Phase	Series PP	DF	GF	AF	Total
A	25	299	108	-	432
B	133	285	5	-	423
C	8	89	-	-	97
D	17	42	8	-	67
E	-	47	2	-	49
F	62	6	-	-	68
G	-	274	1	-	275
H	-	192	126	10	328
I	-	81	33	74	188
J	-	159	26	-	185
K	-	249	-	-	249
L	-	67	-	31	98
Total	245	1790	309	115	2459

d. Series--Landtype

Landtype	Series PP	DF	GF	AF	Total
120c	245	1234	250	10	1739
120b	-	489	59	74	622
109	-	67	-	31	98
Total	245	1790	309	115	2459